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food preservation and canning industry

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The National Productivity Council records its deep appreciation and gratitude for the efforts made by the United States Agency for International Development Mission to India in sponsoring and assisting this Productivity Team

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IN MEMORIAM

A most likeable person, a gentleman and one who endeared himself to all who came in contact with him—Dinshaw Dastur. We lost this inesteemable team-mate just as he was about to reach home after completion of our study tour. He died of cardiac failure at Karachi where the plane was diverted because of bad weather over Bombay airport.

Founder Director of D & P Products Private Ltd., Bombay, Dinshaw Cawasji Dastur—41—held an honoured position in the Canning industry, the promotion of which was very close to his heart.

As we write this report we miss his invaluable assistance. We think of him and bow our heads in homage and remembrance of a friend and helpmate who was near and dear to us and whom an unkind Fate snatched away from our midst so suddenly and in the prime of life.

May his Soul rest in Peace.

PREFACE

The National Productivity Council Team on Food Preservation and Canning Industry visited Denmark and the USA after a careful study of the productivity problems of the industry in India. Some members of the Team visited Hawaiian Island and Japan. Their observations are also included in this Report. The in-country tour had helped the Team not only to grasp the problem in India but also to look for solutions in terms of existing conditions in the country. In writing this Report the pattern followed is similar to the in-country report which is appended at the end of the Report. The programme of the Team in Denmark and the USA was well planned and took into consideration most of the recommendations made by the members.

In preparing this report an effort has been made to stay as close to the factual observations made during the tour as possible and, therefore, all aspects of the food preservation and processing are not reported but only those which were actually observed and studied.

The Team was very much impressed by the systematic planning, proper organisation, careful selection of personnel, control of raw materials and the efficiency of operation of the industry, both in Denmark and the USA. All aspects of productivity receive careful attention right from the production of raw materials until the finished goods reach the customer and are consumed.

Fruits and vegetables used for processing are specially grown. The varieties used have been developed with the specific object of processing. Thus the processed foods have better flavour and texture. Adequate attention is also given to the yield of raw material and, therefore, the cost of production is low.

The plant organisation is efficiently laid out. The buildings are constructed specifically for food processing plants. The designs of machinery and equipment continuously keep developing in order to make the industry more efficient. Maximum attention is paid to the selection of personnel as the efficiency of operation of the entire organisation depends upon the persons who run it. The machinery is so well maintained that it is not difficult to find 30 to 40 years old units in efficient operation. The freedom given to the technical personnel and the appreciation shown for their efforts is indeed very encouraging.

The techniques of material handling are highly advanced and even utilise electronic devices in some cases. It may not be possible for the Indian Food processing industry to utilise all these techniques but the studies indicate the direction in which it would be necessary for the food processing industries in India to take a leap forward.

The developments in productivity have not only helped to increase the efficiency of operation and reduce the cost of production but have also helped simultaneously to improve the quality of the product and provide better service to the consumer.

The regulatory controls have been introduced in Denmark and the USA as a result of the need for such laws by the industry and the rules have been evolved by the Government in consultation with the industry and the public. A conscious effort has always been made to see that the policy followed does not become an obstruction to the development of the industry but provides a helping hand instead, simultaneously protecting the public interest.

The developments in Denmark have an added value for India in so far as most of the modernization of the food precessing industry has taken place after the last war and the manufacturing units are not as large as in the USA.

Scientific research has made valuable contributions to the high level of technological development which has been achieved by the food processing industry in Denmark and the USA. The research programmes of various Government controlled laboratories, universities and the research organisations established by the industry on a co-operative basis are fully oriented to the requirements of the industry. They are aware of the economic contributions which they have to make in terms of money spent on research. The research programmes are prepared jointly by representatives of the industry and the research organisations. This has resulted in speedy development of technology and solution of many problems. Several research programmes are carried out directly in the industry by the scientific workers and, therefore, there is little problem about finding use for the results of research.

Operational research programmes have helped the industry to utilise their facilities to the maximum advantage and to make their working more efficient and economical. India has much to learn in this direction and a well organised effort needs to be made for reorientation of the research programmes as well as for educating the industry to take advantage of the research facilities.

It may not be out of place to point out some of the limitations under which the Team had to work. If some of the members with engineering background could have been included in the Team it would have helped to acquire more detailed knowledge of equipment design and material handling. Similarly there was a considerable amount of emphasis laid in the itinerary on the fish processing industry while no fish processor was included in the Team. These limitations could have been overcome if the itinerary of the Team abroad could have been made available to the members sufficiently ahead of time so that they could have suggested alterations to suit the background of the members more appropriately. The programme of the Team was too extensive and left little room for intensive study of specific problems. If arrangements could have been made to spend longer time at some of the selected units it would have helped the Team to go into details of certain items of productivity which would have gone a long way to help the members to acquire adequate knowledge of the factors which could not be studied during the short visits.

The members of the Team express their gratitude to the National Productivity Council, India and the US Agency for International Development for providing them the opportunity to study productivity in Denmark and the USA and now look forward to assist the development of food industry in India.

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1 : Management

THE TEAM'S VISITS TO THE FOOD PROCESSING plants in United States and Denmark were mainly confined to units having large scale operations. It, therefore, became quite obvious that the problems of management in both these countries were bound to differ in many respects from the conditions prevailing in India. This Report covers the management problems only in so far as they relate to the food preservation industry.

In Denmark most of the modernisation has taken place since the last war and there is a fast growing tendency towards the development of large organisations by combining of the existing small ones, both in the private as well as the co-operative sectors. Experience of Denmark should be a pointer to us for the direction in which we may have to move in order to achieve economy and efficiency through modern management.

In the USA also there is growth of larger organisations. Many of the smaller units are being taken over by concerns having similar or allied interests. During the period 1937 to 1958, the number of establishments canning fruits and vegetables has gone down from 2359 to 1607. In this period, the number of production workers in the industry has gone down from 123,961 to 88,091. The wages of these workers have, however, risen from $ 81,970,000 to $ 252,711,000. The value of despatches made by these establishments in this period has gone up from $ 671,196,000 to $ 2,227,041,000. These figures reveal not only the increasing productivity but agree with the impression gathered by the Team in all branches of the Food Preservation Industry that the larger units are increasing their size whereas the smaller ones are going out of business. This pattern of growth of the industry is due to a large number of factors some of which will be examined in this Report. The course of development has necessitated the change in the management outlook. Many organisations have more than one production unit controlled by a centralised management not only for the purchase of raw materials and sales of finished goods but also for efficient working of the units. Large amount of power is decentralised and the management at the factory level has been given adequate resources of man, material and finance. This freedom of action has proved very effective for completing the work according to the targets of quantity and quality fixed by the central organisation. One of the significant observations of the Team was the high status of technical (technologists, engineers and research scientists) personnel in many organisations. Management in India should take effective steps to improve the status of such staff as it is well recognised that much of the success of plant operation and development programme depends upon their enterprise and endeavour.

In well run units highly qualified technologists, engineers and management personnel are employed. It was observed that in selecting personnel their aptitudes, outlook towards life and the spirit in which the organisation has to be built up and run are considered very important. Due to increase in general level of education in the last two decades the overall standard of personnel has considerably improved and has helped the management to introduce more advanced techniques of management and plant operation.

If an employee has the required aptitude and right outlook but lacks specialised training, managerial or technical, he is selected and then given the necessary background for the duties he is expected to perform in the organisation.

Food processing is a highly competitive business and, therefore, the management has to be very vigilant to take advantage of every new development in the field of technology and marketing in planning their action. The factories make special efforts to develop products for the changing taste. This helps to manufacture specialised products during the off season and to utilise the idle capacity of the plant. An example of this was seen in the working of a poultry packing plant visited by the Team in Portland, Maine, USA. They were concentrating on the development of new poultry products to create new markets as a safeguard against the possible fall in the demand of poultry meat. Many more similar examples could be quoted. The members of the Team feel that the management in India can benefit considerably if they take such bold steps to put new products on the market specially to meet the taste requirements of the Indian consumer and also to develop export market for these products.

Many food processing units work throughout the year in Denmark and the USA although they manufacture a major portion of the goods during their main seasons which are quite short. Planning of production for off season operation is essential to keep the permanent staff busy and to cut down the general overheads.

In many places efforts have been made to develop integrated production units. A good example of this was observed in the pineapple industry in Hawaii. Besides manufacture of main products the waste from the production line is utilised for the manufacture of by-products such as syrup from peel juice and cattle feed from the remaining waste. Similarly the orange and lemon processing industry in California makes use of their entire waste for the manufacture of by-products which bring them good financial return.

One of the major factors which contributed to the quality of the processed foods both in Denmark and the USA is the speed in procurement of raw materials such as milk, fruit, vegetables, fish, meat, sugar and packing materials. Because of this efficiency the management is able to maintain greater control on the supplies and keep their inventories low. The finance utilisation is consequently very efficient. Management of some of the factories plan production of seasonal agricultural produce through contracts with growers. In some cases where the yields turn out to be very high the contractual conditions are honoured and much larger quantities of the goods are manufactured. This establishes faith between the growers and the management. Such a situation sometimes creates serious problems for the management as it involves holding of large stocks and selling them in the highly competitive market. The industry can take such risks only where suitable banking facilities are available to the processors at reasonable interest. Some of the efficient units reported that they turn over their capital 18 times in one year.

In the USA standard contract terms have been worked out for agreements between processors and the growers. These contracts are usually signed before the sowing season and are based on the estimate of the annual demand for processed goods prepared in the autumn of every year. The grower then plants his crop according to the requirements of the processor. A contract form is reproduced in Appendix B. The development of such a system may be useful to the industry in India.

In most of the food processing industries accounting operations are mechanised. Some of the large ones make use of electronic computers which can also analyse the data. This development is taking place quite fast and has helped in making scientific studies on various aspects of management and sales. The use of computers, however, calls for a large amount of spade work leading to selection of suitable punch card systems. It is also necessary to employ well trained personnel for operating these machines. The mechanical data processing is quite complicated. One of the senior executives of a plant visited by the Team stated that the data is helpful mainly for the purpose of informative understanding and is not always useful for management control. This development does not seem to have much

possibility for use in the Indian food processing industry at present.

The Indian food preservation industry would do well to recognise the three important factors, which form the key note of productivity for the success of the industry in Denmark and USA.

(*i*) High production in the field of agriculture and animal husbandry.

(*ii*) Efficient material handling at all levels of operation.

(*iii*) Effective management by means of budgetary and inventory control and full utilisation of the plant capacities.

The study of the Team during the in-country tour shows that there is need for developing food processing units of optimum size which would be efficient. This requires a careful study of the existing situation in the country based upon the following :

1. Investment
2. Marketing possibilities and consumer education
3. Technical personnel
4. Raw materials—quality & quantity
5. Equipment.

These factors have been very carefully studied in Denmark and the USA in relation to the overall social and economic conditions. If the management in India could understand these factors in terms of the conditions obtaining in the country it should not be difficult to develop better control on each one of these factors and operate the industry with greater efficiency than at present, perhaps through consolidation of the industry into economic units.

For purposes of comparison the organisational set up of one of the large manufacturers visited by the Team is given in Appendix C.

Management in Co-operatives

The field of co-operation has made tremendous advance in Denmark and the progress of co-operatives in the USA is also quite significant. The Team's attention was particularly drawn by the success of co-operatives in Denmark as they have become a part of the peoples life in that country through large number of activities like marketing, processing, credit, housing, etc. The co-operative movement is a tradition in the country and, therefore, it has not even been felt necessary to enact a co-operative Law. The co-operatives are only just registered. The by-laws are simple as can be observed from a model at Appendix D. The efficiency of management of the co-operatives seems to be the base of this successful growth and development. The elected chairman and directors only lay down policies while the day-to-day management is left to the executives. Large number of co-operatives attract highly qualified technologists and executives because they provide the necessary avenues for the best in employment. There is freedom of action and independence in technical matters. The co-operatives in Denmark are particularly fortunate in having *fine leadership* and the process of finding new leadership has been continuous although it was reported that small societies do have difficulties in this regard.

Danish Co-operative Wholesale Society which was started in 1866 as a rural movement appears to be of special interest for India as its experience may be useful and serve as a valuable guide for our co-operatives. They have about 2000 local societies under district co-operatives. The district representatives elect members of the Board of directors of the central organisation. It is reported that 1/3rd of the population of Denmark is connected with the co-operative movement in one way or the other. The economic link which this society provides to the individual member serves a very useful function. The federated union provides many services amongst which there are training programmes like :

(*i*) How to be a chairman or a director,

(*ii*) How to organise meetings, conferences, etc.

Such programmes keep up the tempo of the movement. The co-operative union runs an audit service for the members through their central account and audit department. Besides this, they provide to their customers and to the primary societies service of central laboratory to test the products and a test kitchen to popularise good nutritional habits, and consultation service on various problems including architecture and design.

The Danish co-operatives have been well organised in meat and dairy industry and run a large number of processing units for the primary members. At the present moment there is a movement to integrate 1300 small co-operative dairies into a few (about 10) large scale units with modern plant and machinery. It has been found that for the control of quality and economics of production, as well as from the point of view of the availability of technical staff, it is necessary for the Danish Dairy Industry to consolidate. The example is a timely pointer to the present public sector and co-operative dairies which are being established in India.

In Denmark they have constituted a number of special boards for export of food products such as butter, cheese, meat, and poultry products and others. Unlike our export promotion councils these export boards actually undertake direct export on behalf of their members. The export trade is the life line of Danish economy. It is reported that 60% of butter, 70% of cheese and the entire quantity of evaporated milk and milk powder are exported. The figures for meat also indicate very large exports.

The Danish Agricultural Council which is the apex organisation of various co-operatives performs a very useful function of collecting, co-ordinating and collating of various data for the agricultural produce.

The Team visited one of the largest co-operatives slaughter houses in Odense, Denmark. Actually out of 67 slaughter houses 62 are co-operatives. Some of these slaughter houses run co-operative processing units. The Team visited JAKA Co-operative meat processing factory in Aarhus which was started in 1954 by 19 co-operative slaughter houses. The management of the JAKA unit reported that they had improved their operation by using better and more modern equipment and machinery. The management was satisfied that the members of the co-operative recognised the value of improved methods both in management and production and gave them considerable amount of powers to take decisions for improving the work.

The Scandinavian countries have now come together to form the Scandinavian Wholesale Co-operative Societies which play a very useful role in the trade and commerce of these countries. It was observed that one of the important items of import was oil seeds and oil cakes. It may be possible to explore this market to our advantage.

In the management of one of the largest co-operatives in the USA, the California Citrus Exchange which handles marketing and processing of citrus fruits, the elected representatives from the District Exchanges participate very effectively. The striking feature is that the board meetings are open to the public as well as to the grower members. This results in rousing considerable interest. In spite of such open participation it was reported that the management had no particular difficulty in carrying out their functions. A very able general manager is at the helm of the organisation. Under him there is an assistant general manager with seven directors, one in charge of each department, who are full time executives.

The Co-operative has 52 sales offices in United States and has direct connections in Europe, Japan, Hongkong and other areas of the world which provide large marketing facilities for fresh fruits packed for shipping.

It is reported that 50% of the lemons, 65% of Valencia oranges and nearly 85 to 95% of Washington Naval oranges are sold fresh in the market. Whatever produce is not sold or is below the grade for the fresh

market, is sent to the processing plants which are capable of handling large quantities. The returns to the producer are double when the produce is sold fresh as compared to the amount received by him when it is utilised for the manufacture of products. This organisation controls about 70% of the citrus crop in California.

Co-operatives in United States are controlled on federal as well as state levels. The farmers' produce is purchased on a flat rate basis and at the end of the year the prices are worked out after deducting the expenses incurred for packing, processing, marketing and products divisions. The co-operatives are not liable to pay any income-tax.

The growth and development of the California Citrus Exchange (Sunkist) Organisation is an example of successful co-operative operation for the benefit of the growers. We also have similar organisations in India such as the Nagpur Orange Growers Co-operative Association and the Coorg Orange Growers Co-operative Association and a few others who have been doing some useful work in this direction. The Team feels that they should adopt modern practices particularly for packing and distribution of fresh fruits to develop a nation-wide market.

Successful marketing of fresh fruit which brings better returns is a pre-requisite to successful processing of citrus fruits. To attain the best results in the co-operatives the producers should remain out of the day-to-day functioning and leave the management to carry out the responsibilities in an objective manner without fear or prejudice to anyone.

The milk co-operatives in United States have come in for some heavy weather in the recent years particularly because some large chains, which control nation-wide market for liquid milk and milk products, have entered the business. It seemed as if the co-operatives may have to remain out of the field of distribution and marketing and may have to continue only the processing or manufacture of milk and milk products. The Pure Milk Association which has its operations in several States in the Mid-Western region of the USA has effectively organised a large number of units for its member producers living in different States. This organisation has found it practical to distribute liquid milk and part of its milk products through various agencies. Due to inter-State link the Co-operative has become highly successful. Should we not develop similar inter-State link between our Co-operatives ?

Another co-operative which left deep impression on the Team was the Blue Lak Packers which processes beans and other vegetables in Salem, Oregon. It was reported that this co-operative pays up to 35% higher price to its members for their produce than the normal market rate. Only 50% payment is made to the growers for the raw material when it is delivered and the balance is paid as the finished product is sold. Here also the principle is to deduct the expenses and the remaining amount paid to the grower members as the price of the raw produce. However, a revolving fund is created to undertake expansion programme and to raise working capital. This fund operates on a long-term basis out of which $\frac{1}{3}$rd is returned in three years while the remaining $\frac{2}{3}$rd is returned in 7 years. The single product operation for the manufacture of each product is adopted by keeping separate accounts for each crop and only general cost of administration is charged on a broad basis. The cost is worked out on the basis of averages and adjusted at the end of the year.

In spite of the fact that in the above organisation the growers are directly the owners of the processing plant, the cannery controls a large number of operations in the field to obtain the right quality produce. The joint operations make it possible for the growers to use results of research and employ the equipment and facilities which may be difficult for each individual member to obtain. This helps to increase the crop yield, improves the quality, use the most efficient techniques of harvesting and transport to achieve high level of productivity.

It is felt by the Team that the co-operative movement for processing and marketing of a

number of different commodities, if properly organised, may produce highly successful results in India. For certain classes of fruits and vegetables it may be helpful to set up a federated co-operative union which could handle produce from a group of districts. This would provide the marketing and processing units with raw materials of varied nature and the necessary turnover for economic level of operation. Since many of the operations are similar, it will be possible to process several varieties of fruits and vegetables in one plant. The emphasis which we would like to lay here, is that the existing pattern where the fruit processing industry has to obtain its raw material supply from the fresh market should change and the supplies should come from the farm directly to the factory. This would benefit both processors and the producers.

2 : Raw Material

THE FOOD PROCESSING INDUSTRY, DEPENDENT upon agricultural produce for its basic raw material, has a different concept of growth and development in Denmark and the USA as compared with the concept in India. In those countries the raw materials are meant for the industry and not the industry for the raw materials. As a result the best raw materials are specially grown for the industry. This clearly shows that unless we change our outlook our industry cannot achieve the high standards of quality and economy in respect of raw materials as well as the finished goods. The progress of our industry can only be in direct relation to the development of raw materials suitable for processing. The present programme for developments in horticulture and animal husbandry do not present a hopeful picture for the immediate future. Therefore, the industry will have to face, for a considerable time, the problems of obtaining suitable raw materials for processing. Naturally, the major concern today is to determine what should be the desired course of action to correct the situation. It is, therefore, necessary to examine the subject in some detail.

Suitability of Varieties

This is one of the most important factors in procuring raw materials for the industry. Time and again it was observed by the Team how the research in horticulture, economic botany and animal husbandry played important role in developing new varieties for processing. The processors not only insist upon growing the varieties of their choice but continuously carry on work to improve the varieties for making them more suitable for processing. To give a few examples, in Denmark the special Danish land race of pigs has been developed for the meat industry. This breed is highly suitable for processing and has been responsible in large measure for the popularity of the Danish meat all over the world. To protect the interest of the industry the export of live pigs of this breed is prohibited.

In Denmark different varieties of peas have been selected on the basis of their suitability for processing. The canner pays for the peas according to quality and maturity. In order to run the factory for longer durations, different varieties of peas, early, middle and late are grown so that they mature during different parts of the season.

In California two varieties of oranges, viz. Washington Naval and Valencia have been popularised. The fruits of these two varieties are available in two different seasons, one lasting from April to September and the other from October to March. This facilitates control for fresh marketing and processing. The development of suitable varieties for preservation is a dynamic process. Several examples of this can be pointed out. The Marshal variety of strawberry which was once very popular, is now being fast replaced by new varieties which are resistant to certain diseases. Development of suitable fruit and vegetable varieties for processing requires a programme of research in plant breeding and processing over a period of years in collaboration with farmers and processors. Although all concerned in India have begun to recognize the need for a study to evolve suitable varieties for processing, very little progress has been made in this field. The concern should now be translated into action expeditiously and a programme of research work started by the Central Food Technolo-

gical Research Institute and its Regional Stations or the Indian Council of Agricultural Research and the Departments of horticulture in the states. The industry must be taken into confidence for this work and the research projects should be drawn up with its active collaboration. The manufacturers who are interested in any particular field should also associate more actively in this programme and even consider financing the research to an extent. In the USA the contribution of the National Canners' Association in developing suitable varieties of fruits and vegetables for processing, is well known. The Association has financed a large programme of research in plant breeding at a number of State Agricultural Experiment Stations and farms in different regions of the USA. Varieties of tomatoes have been developed which give yield of 18 tons per acre as against the normal yield of 7 to 8 tons a few years ago. Special efforts are being made to develop varieties of tomatoes and beans which can all mature at the same time, so that they can be picked by mechanical harvesters at one time. Efforts are also being made for breeding tomato varieties which would not crack when picked mechanically. The National Canners' Association is spending 11 million dollars a year on research work for raising agricultural crops suitable for canning. Six canners in Michigan State are financing a project at an expenditure of $ 75,000 for finding out a variety resistant to Phytopthera disease. Even the food machinery manufacturers, like the F. M. C. Corporation have a large research division which works in very close co-ordination with the processing industry. They are constantly working to develop harvesting machines to suit the requirements of a variety of agricultural crops which are being developed by the plant breeders for the industry.

The Department of Horticulture and the Department of Food Science and Technology at the University of California, Davis, are undertaking extensive research work in close co-operation with the growers and the food processing industry. The horticulture department of this University is working on tomatoes, beans, strawberries and other fruits for evolving suitable varieties for canning and freezing. The controlled ripening of pears developed by the department is an example of close co-ordination with the industry. The pears are harvested at a particular maturity in the climacteric, while they are still green, and are later held at a certain temperature and humidity in cold storage. They are removed from the storage and warmed up in a continuous water bath (at 92° F.) and then stored in boxes to speed up ripening. This technique of controlled ripening of the quantity required daily for processing has been very helpful to the industry.

Similarly, the Department of Horticulture, Agricultural Economics and Food Science and Technology of the Oregon State University, Corvallis, Oregon, have a major plant breeding programme for evolving varieties of beans, tomatoes, strawberries, raspberries and blackberries, which may meet the requirements of the processing industry. The entire research programme is geared to the production problems of the food processing industries. Experimental work on cultural practices, fertilization, pest control, irrigation requirements, etc. is undertaken by the concerned departments with a view to produce agricultural crops of the right quality, for the industry. One of the main objects of the State University is to provide service to the industry.

From the above, it is clear that there is a very close co-ordination among the farmers, private research organisations, universities, State departments of Agriculture, National Canners' Association, food machinery manufacturers and the food processors, with the result that the food industry in USA is very well organised to serve the consumer by supplying the high quality goods at reasonable prices.

Producer & the Industry

In the United States and Denmark the relations between the producers and the processors are on a different level than what we generally find in India. Since the processors are the largest single buyers of the produce, they are in a position to materially decide many aspects of agricultural production. This is a great advantage. In India most of the agricultural produce is not sur-

plus and is sold on the fresh market where the processor has to compete against a consumer of fresh goods to purchase his requirements. Whatever little surplus arises during the short peak season is not adequate for the requirements of the food preservation industry. It was noted that the food processing industry in the United States and Denmark has developed as a major necessity and is an important factor in their national economy. It is, therefore, in a position to determine the factors for its growth and development. Thus the conditions are basically different from ours. This, on the contrary, is a very useful lesson for us in India. We must recognise that in order to build the industry large scale development of our agricultural economy is an important necessity. Having recognised this, it is clear why the price at which raw material is available to the industry in USA and Denmark is so highly competitive and reasonable. This is pre-requisite for the development of the industry. Often it was observed that raw product factor was not very large in the final cost of finished products.

The procurement of raw materials varied according to nature of the produce. In Denmark the peas are grown by farmers who have more or less leased their holdings to the processors. Almost all agricultural operations such as supply of seeds, fertilisers, control of disease pests are taken care of by the industry. Farmers generally sign a contract for growing the varieties required by the processors. Predetermined price is paid to the growers and this is according to the quality of the produce which the processors harvest from the field. The scheduling and control of harvesting is done by the processor. Most of the farm holdings in the neighbourhood of the processing plants were willing participants under these conditions, and it was estimated that the farmer's return was Rs. 1000 per acre in Denmark. The price paid by the processors is Rs. 50 per 100 kilo of shelled peas. A regular system of farm contracts has been worked out by the management of the factories. If similar farm contracts could be introduced in India they would prove highly beneficial to the growers as well as the processors.

At Odense, Denmark, the Team visited one of the most impressive handling and packing organisations run by a Growers Co-operative known as GASA, which operates an auction market for fruits, vegetables, flowers and shrubs. The auction hall is like a big lecture theatre with elevated sitting arrangement for about 200 bidders. Each desk has facilities to contact outside market through telephones. The bid is started from the highest expected price and the hand of the price clock moves anti-clockwise. As the price declines the bidders are expected to press the button, which is provided on each desk to indicate their acceptance of the price. As soon as the button is pressed a red light appears on the clock which indicates the seat number of the bidder and the clock stops indicating the price. The produce is also placed on a circular conveyor belt which keeps moving in front of the auction clock, so that the buyers can see it in front of them. This way the bid is very accurately recorded and the producer has the advantage of getting the best price. The management of the co-operative looks after the interest of the growers. This includes presenting the produce for the auction and shipping the consignments to any place in Denmark or anywhere in Europe from their own railway siding. The organisation also provides, at a suitable charge, a grading service for the fresh produce to the farmers. The produce is handled by personnel trained in collecting, inspecting, grading and packing of varieties of fruits, vegetables, flowers and shrubs. This enables the producers to obtain maximum price advantage, and at the same time helps the customer in purchasing the right quality of material in the most suitable packing. The management pays the farmer the price as per auction after retaining the service charges. The farmer members are required to put up for auction all their produce unless they have indicated their desire not to do so in advance.

It is the Team's opinion that auctions in many of our markets could be organised along the lines studied in Denmark. Facilities for packing and grading should also be provided. This would result in considerable saving of the available protective foods and

give better returns to the producers. It will also facilitate marketing because grading and proper packing will improve handling. The management has to play a part of an honest broker which can be done only if it takes detached interest. If an auction organisation is created to handle the produce in this manner we should obtain help from the Danish or Dutch Co-operative organisations or from other countries where the movement has developed to an advanced level.

Another instance which may be of interest is the method of procurement of chickens in Portland, Maine, USA. Only 8 weeks old chickens weighing 2¼ to 2½ lbs. are accepted for packing. The birds are of the same breed (Red Rock) and predominantly female. Not only the weight of the bird but the feed given to the chicken is controlled by the processor both from the point of quantity and quality. Five lbs. of feed produces a chicken of 2½ to 2¾ lbs. in 8 weeks. It was reported that a large hatchery was maintained by the processor to supply pullets to the chicken houses.

The fixation of prices and details with regard to certain fruits and vegetables have been discussed separately. Industry gets the raw material from within a reasonable radius, and the most important aspect of quality control at the field level is looked after by the processors directly.

3 : Plant Layout Equipment and Services

Location

ALMOST ALL THE FRUIT AND VEGETABLE processing factories in Denmark and the United States are located in or very near the raw material growing areas. This makes it possible for the processors to directly supervise and control all aspects of growing including supply of seeds, selection of variety, harvesting, pre-packaging and transport of raw material to the factory.

Fish canneries are also located on the wharf where the catch can be unloaded directly into the factory. In fact, portions of canneries are built over the water surface on piles so that the factories may have their own docks and the effluent may be discharged into the water.

Meat processors in Denmark have direct contract with the slaughter houses which are located in the live-stock rearing centres.

Denmark comprises of several islands and, therefore, the fruit and vegetable processing plants are located in the port areas so that loading of finished goods for export presents no problem and is very economical. Coal, which is the main fuel, comes by ships and is unloaded almost directly into the plants.

Building

The factory buildings for canneries, freezing plants, dehydration units and packing houses are specially designed, taking into consideration the type of products to be manufactured and also the desired capacity. In most cases, adequate provision is made for future expansion. In the USA, there is no shortage of land and, therefore, the factories are generally housed in single-storeyed lofty structures with wide roof spans. Minimum possible obstruction is introduced between pillars which support the roof. This makes material handling much easier as conveyors of various types, elevators and forklift trucks are used. Flumes are also used extensively for handling delicate raw material which may be crushed by other modes of conveyance.

In Denmark, and also in the USA, some multi-storeyed buildings are used to an advantage because the gravity flow, specially of liquids, from the upper floors helps in cutting down power requirement and also isolates one process from the other so that it is possible to have specialised control and supervision on each stage of processing. Such constructions are preferred where land is expensive or the operations demand a multi-storeyed building.

It has become necessary for the canners in the USA to have large warehouses because the super market chain stores who purchase larger quantities of the canned goods for retail sales lift their supplies as they are required.

In the USA, wood is extensively used for construction along with R. C. C. and steel. This is possible because the suitable quality of wood is available in large quantities at a reasonable price and the climatic conditions permit its use. The warehouse floors are almost entirely made of cement to permit use of forklift trucks. Roofs are very high to permit high stacking of goods.

In Denmark, some of the new warehouses are made of tubular structure. Floor surface is tarred as this is economical. The cost of the such construction is around 100 kroners (Rs. 68.94) per sq. meter.

Loading & Unloading

Most of the cannery floors in the USA and Denmark are at load-bank height and the buildings are so constructed that on the one side they have the railway siding and on the other facilities for loading and unloading trucks. The Danish canneries are located near the wharf from where ships can be loaded directly. Such an arrangement adds to the handling efficiency considerably. The width of the loading platform varies from 10 to 20 and the length is usually as much as one side of the factory building.

Drainage

The floors have adequate slope to facilitate drainage of wash water into large concrete channels of 18" to 24". These channels are covered with metal grid. At the end of every channel, where the effluent and the waste is discharged into the main sewer, vertical cylindrical screens are provided to prevent large pieces of waste material going into the sewage. The screen can be lifted out and easily cleaned. This prevents blocking of the drains. Wherever the pieces of waste are large they have to be disintegrated into a specified size to pass through a screen before they are discharged into the sewers.

Ventilation & Lighting

The problem of ventilation is well taken care of by the construction of large doorways to permit easy movement of the forklift trucks. Large windows with metal frames and glass panels provide adequate lighting. Maximum advantage is also taken of the north light in the construction of roofs. Wherever artificial lighting is used the specifications laid down by the American Institute of Illumination Engineers are followed.

SERVICE

Water

Most of the canneries located in the rural areas have their own tubewells for water supply. The plants located close to the urban areas make use of the city water supply. In most cases there did not appear to be any serious water problem. It is generally estimated that for one case of fruit or vegetable products manufactured 40 to 50 gallons of water is required. Wherever water is chlorinated precaution is taken to make sure that the break-point is reached and after that not more than five parts per million of free chlorine is available. Break-point chlorination prevents development of off odours.

Steam

In most cases, standard unit water tube boilers are used. These are oil or gas fired depending upon the availability of the type of fuel. The boilers are usually located in a corner behind the retorts so that there is no pressure drop for cooking and the steam is utilised efficiently. On the Terminal Island in Los Angeles there is a co-operative steam plant which uses natural gas, from the nearby oil producing areas, for fuel. Most of the boilers used are automatically controlled and do not require an attendant.

Electricity

The electricity required for the processing plants is obtained from the public utility system. Only in one case a stand-by generator was observed. This shows the absence of power failures and difficulties which normally arise in our industrial centres.

Materials Handling

The largest single factor, which has contributed to the high level of efficiency in the American canning industry, is the development in the techniques of materials handling. This has made a very valuable contribution in reducing the cost of handling and has also speeded up the operations. The

extent of automisation used in Denmark and America may not be applicable to the Indian conditions but the observations certainly give us a picture of the direction in which we have to ulimately advance if the industry is to make real progress and pay better wages to the workers so that they may some day become consumers of the products of their own labour.

Mechanical aids are used at every level of plant operation. In fact mechanisation begins even earlier. Harvesting of fruits and vegetables is done mechanically. In certain cases, special varieties of raw materials are developed which lend to mechanical harvesting and handling. In doing this, however, sometimes the flavour of the produce has suffered. The trucks are loaded mechanically in the field. They are also unloaded machanically at the factories. More emphasis is laid on the bulk handling of raw materials. The ordinary lug-boxes are being given up in favour of bulk bins which can be handled by forklift trucks. Special dumpers have been designed to empty the bins mechanically into the washers.

In the case of fish canneries, fish is dumped from the hold of the boat to the storage tanks located in the factories.

The use of forklift trucks is very extensive in all the food processing plants. The electrically operated vehicles are now preferred to those operated on petrol engines. The former avoids the collection of fumes in factories specially in cold storages where ventilation is extremely limited.

The use of these trucks, however, requires complete palletisation of the raw material and the finished goods warehouses. These trucks are used for unloading the raw materials and supplying them to the plants. At the warehouse level, they are used for collection of goods from the line and stacking them high in stores. These trucks are very efficiently used for loading finished goods into roadway trucks and railway wagons. There is a new trend to save on warehousing space where the trucks with different types of fork arrangement are used. These trucks are able to lift the entire load from the pallet and stack it in the warehouse without the pallets. This is only a new trend and still seems to be in the experimental stage.

Pallets have been standardised in the whole of the United States and there are private pallet companies which look after their maintenance. Thus it is not necessary for the pallets to come back to the same plant which originally sent them out. This saves tremendously on transportation of pallets over long distances.

The in-plant mechanical aids and materials handling methods vary considerably from plant to plant and depend to a large extent upon the size of production desired and the type of product manufactured. A number of canners manufacture different types of products during different seasons. The equipment used by them for each type of product is different. It is dismantled and removed at the end of each season and different equipment is installed for the next product. In some canneries which manufacture two or more types of products at the same time, different production line are used simultaneously.

Peaches are unloaded, washed, cut, pitted and peeled automatically. After that they are passed out to an inspection belt where they are checked for any left-over pits, blemishes or any other defects by women workers. The entire process is so arranged that it has very little dependence on human factor.

Pears are also handled in a similar manner except that the machinery used for peeling and coring is quite different. Several units of each type of equipment are used to achieve the desired capacity. If production in India can reach a certain level it should be possible for the manufacturers to use one or two such units. In fact two pear peeling and coring units are being used in Japan by canners having a maximum production capacity of 10 tons per day.

For vegetable processing also the operations of harvesting, loading, unloading at the

plant, washing, grading, cutting, etc. have been fully automatised.

In Denmark, pea viners are used. Each viner has a capacity of five to six tons per hour. Entire vines, including pods, are fed into this machine. The waste comes out at one end. It is loaded into trucks directly and sent for making animal feed. The peas come out at the other end and go into the washers. There onwards they are graded for size and maturity and inspected for overall quality before blanching, cooling and filling them into cans. It may be advisable to introduce the use of one or two such viners in India by some of the large pea canners provided they can have control on growing and harvesting and are not located too far from the growers.

In the case of string beans, grading for size, snipping off the ends and cutting are all automatic operations.

The filling of vegetable into the containers is done automatically in large plants and semi-automatically in smaller plants.

The speed of filling the containers depends upon the size of operation and type of equipment used. In certain cases, the filling speed is 300 cans per minute, to match with the speed of the seamers. Strained baby foods and junior foods are filled at the rate of 600 to 700 jars per minute using 32 head rotary fillers.

In the fish processing industry, a number of operations are manual and they use comparatively less automatic equipment. Here also the material is handled on conveyors and the efficiency is quite high. Stainless steel conveyor belts are used in some of the modern plants for conveying prepared fish. In one of the fish processing plants, the speed of seamers was up to 750 cans per minute and two or three preparation lines were feeding one high speed vacuum seamer.

On the preparation line, where the food comes in direct contact with the equipment, stainless steel is used but in case of non-acid products the use of galvanised iron or mild steel equipment, coated with Epoxy paints, is common. There is no unnecessary fad for the use of stainless steel, although most of the new installations are making extensive use of stainless steel. In Japan also the use of stainless steel is not very extensive.

Depending upon the size of operation, continuous or stationary retorts are used. The trend is, of course, towards the former for reasons of economy and ease of operation. Large operators state that continuous cookers, although initially very expensive, are economical, and provide better working conditions as there is no free steam in the cannery. Stationary retorts are also in use in some of the older plants and are preferred for certain products, specially those packed in glass containers. All the retorts, whether continuous or stationary, have automatic controls with recording charts for time and temperature.

Continuous atmospheric cookers are used for processing fruits at a number of places, but generally the large quality conscious processors prefer the continuous pressure cookers even for fruit products as they give them more precise control on temperature and pressure of cooking. This is particularly the case in processing of pineapples in Hawaii.

Handling of Empty & Filled Containers

Flattened cans are not used anywhere. Reformed containers are supplied to the canners. These are handled mechanically throughout. The can manufacturers have helped the processors by evolving a very efficient can conveying system. A mechanical unloading device has been developed for unloading pallet loads of reformed containers into the conveyors. The cable conveyors are used almost entirely for transport of empties to the filling line. Filled cans roll by gravity to the warehouse and are lifted up to higher elevation by double belt conveyors or elevators, wherever necessary, and again allowed to roll on the angle iron conveyors.

Label

The labelling operation is automatic. The speed of labeller varies from 400 per

minute to 1200 per minute. Larger plants use several labellers. Usually one labeller is used for one size of container although the machines are adjustable to different sizes. In some of the plants, cans are filled into the card board cases manually after labelling. In larger and more modern plants this is done automatically. The cases are glued and sealed automatically. The only manual operation is the placing of the cases on pallets.

In some cases unlabelled cans are stored on pallets because the manufacturers sell these to marketing organisations such as the chain stores who prefer to use their own labels. As and when the supply orders are received the containers were labelled for the buyers and despatched to them. Bulk containers are stored without labels. This is particularly the case for pineapple cubes packed for re-use in fruit cocktail. Craft paper separators are used between layers of cans to permit proper stacking. Six or seven layers of cans are stacked on pallets in this manner.

4 : Production

THE LEVEL OF PRODUCTIVITY IN THE Danish and American Food Processing Industries is very high and this is particularly evident in the Production Departments. This has been necessitated by the very high cost of labour and the large investment in the high capacity automatic machinery.

The wages in the United States of America vary between $ 1.75 per hour to $ 2.50 per hour while in Denmark they are around 4.75 kroners (Rs. 3) per hour in the Food Processing Industry. The capacity of the equipment used by the industry is very high and has to be utilised fully in order to justify the investment. The machinery suppliers generally state that they normally expect 85 per cent utilisation of the machine capacity. Some of the plants have, however, been able to use the equipment up to 115 per cent of the rated capacity. In order to make use of the labour and equipment at the maximum efficiency level, it is very necessary to synchronize all the operations, so that there are no bottlenecks. Stoppage of work even for a few minutes can result in very heavy losses. It is very difficult for the Indian Food Industry to conceive of any such problems at its present level of operation. The time is, however, fast approaching when the very factors which make it necessary to raise the productivity level in the United States and Denmark will also make it necessary for the Indian industry to think along similar lines.

Use of modern machinery has also made significant contribution to the improvements in the quality of the product.

Procurements of Raw Materials

Production planning begins with the signing of the contracts with the growers. The quantity of raw material required is based on the figures of the estimated sales of finished products which the management is able to compile in the autumn of every year. After this the field department contacts the growers and decides upon the acreage of each crop to be planted or contracted for. *The quality control begins at this point and continues until the food is processed and warehoused.* The Food Processor decides on the variety of the crop to be grown, the fertiliser programme, the pest control schedules and the harvesting time. The crop is thus grown under the direct supervision of the Field Department which works in consultation with the Production Department.

The correct maturity for harvesting the crops is determined by the use of various techniques which have been well standardised. The maturity of peas is determined by the use of tenderometers and for the beans by the use of special gauges to measure their thickness and length. The maturity of pears is determined by means of a puncture tester. The developments of sugar, colour and acid are other indices of maturity for fruits.

A very conscious effort is made to reduce the time lag between harvesting and processing. It was reported by one of the processors in Denmark that peas went into the cans within 55 minutes of harvesting. This ensured the quality to a considerable extent by preventing microbial deterioration and not allowing time for conversion of sugar into starch.

Some fruits such as pears are harvested and stored at low temperature. They are ripened under controlled conditions as mentioned in the Chapter on Raw Materials. This helps in controlling the maturity of the

fruit used for processing and also in prolonging the season.

The fish processing industry makes use of the fresh catch as long as possible and after that uses the frozen fish to continue the operation. It was noticed that a considerable amount of frozen fish, particularly Tuna, is imported by the processors in the United States from Japan.

The raw material supplies for the meat, poultry and milk processing industries do not vary from season to season as widely as in the case of fruit and vegetable processing industry. Although slight variations occur from season to season, it is possible to control them in such a manner as to maintain the production fairly uniform. In order to produce poultry and eggs economically, it is necessary to have at least 30.000 birds per farm.

Harvesting & Transport

Although several crops are hand-picked even today, efforts are being made to mechanise all harvesting operations. Pea vines are harvested and loaded into trucks by automatic machinery. On an experimental basis a mechanical bean harvester was being tried near Portland, Oregon. Efforts are also being made to develop automatic fruit harvesters. A tomato harvester has recently been developed and is being tried in different parts of the United States.

The use of lug boxes for transporting fresh fruit and vegetables from the field to the factory is still quite common but they are being fast replaced by large wooden bins which can be mechanically handled. A considerable amount of research work has gone into the designing of the size of these bins so that the fruit and vegetables transported in them are not bruised or damaged.

For certain delicate fruits like strawberries there is no choice but to hand-pick them with the utmost care. They are placed in one pound open cardboard or paper-mache boxes which are arranged two dozen to a crate and then transported to the factories.

Both in Denmark and the USA the synchronisation between the harvesting of the crop and its consumption in the factory is almost perfect. For this purpose radio communication is extensively used. The radio contact is maintained between the factory, the field, the vehicles transporting raw materials and even the cars of the field supervisors. This assures absolutely fresh supplies and prevents unnecessary accumulation of raw material after harvesting at any particular place, specially at the factory.

Although the use of modern automatic equipment may not be possible in India for some more time to come there is urgent need to establish close working relations beween the food processors and the growers. With proper assistance to the agriculturists it should be possible to grow varieties of crop suitable for processing and increase the yield per acre by the use of proper fertilisers and control of the insect and microbial pests. By establishing close relations with the growers, the processors should also be able to determine the correct time of harvesting so that only the raw material of correct maturity is packed. Increase in the yield would help the grower. The concerned Government organisations, such as the Horticultural Research Stations, can play a vital role in developing suitable varieties of raw materials and then giving proper advice to the growers and the processors through their extension service.

Receiving

As soon as the raw material is received at the factory it is automatically weighed and sampled. The lug boxes or the bins are emptied on a conveyor which carries the produce to the washing machines. The use of large bins is eliminating the preliminary receiving conveyors as the forklift trucks are able to empty the material directly into the washer. The samples are analysed and reports sent to the laboratory as well as the management. In most cases payment is made according to the quality of the raw material.

Materials Handling

The advances made in materials handling in the United States of America and Denmark are indeed very impressive. A

considerable amount of work is done in developing the materials handling equipment by the manufacturers of food machinery, container suppliers as well as the engineering departments of universities and research institutions.

It may not be possible for the food processing industry in India to make use of a number of highly automatic units but the time is approaching fast when such equipment will have to be used. To begin with conveyor belts could be used to a great advantage for the preparation lines and for the movement of empty and filled containers. Use of such equipment would also raise the efficiency of labour and help to synchronize various processing operations more uniformly.

Off-season Operation

In order to utilise the machinery fully and to reduce the burden of overheads most of the food processors plan winter operations for the manufacture of products like French fries, jams, juices, soft drinks from citrus juices or concentrates and juices from dried fruits like prunes.

It was observed that fruit and vegetable processing industry operates in the USA for 200 days per year in the warmer areas and 150 days in some of the cooler areas. In Denmark the main operating season is considerably shorter.

Some of the fish processors had organised the work in such a manner, that they could operate throughout the year, using frozen fish during the off-season.

The details of machinery and equipment used in the manufacture of a number of important commercial products are given in the sections of this chapter which follows.

A. Processing of Pineapples

The magnitude of pineapple industry can be seen from the fact that it is the second largest industry of Hawaii and packs different types of the products valued at $ 120,000,000 (Rs. 576,000,000).

Hawaii produces 53 per cent of world's pineapple. The entire pineapple industry employs 23,000 persons and pays $ 41,000,000 in wages.

The buildings in which the pineapple canneries are housed are specifically designed. They are located very near the port to save on handling and transport for despatch of goods to the mainland of the United States. The maximum distance which the pineapple has to travel from the field to the cannery is 60 miles.

Seventyfive per cent of the pineapple pack is prepared between the 15th of May and the end of August. The canneries are inactive from October to December and operate on a limited scale from January to April. In addition to the canned products, fairly large quantities of frozen juice concentrate and other products are prepared.

The 1961 pack of pineapple products in Hawaii was as follows :

Slices	—	8,924,120 cases	
Fancy cuts	—	5,917,678 cases	(including small amount of frozen chunks, titbits, cubes, etc.)
Crushed Pineapple	—	6,136,627 cases	
Total :		20,978,425 cases	

The break-up of the pineapple products packed in different sizes of containers in 1961 was as follows :

Sl. No.	*Size of Pack*	*Capacity of the container at 68°F in Avoir ounces*	*Quantity*
1	8 oz.	8.68	771,426
2	No. 1 Flat	8.89	2,107,370
3	No. 211 Cylinder	13.56	2,616,608
4	No. 1¼	...	1,281,462
5	No. 2	20.55	6,514,946
6	No. 2½	29.79	2,762,980
7	No. 10	109.43	4,923,633

It is stated that the present smooth Cayenne variety of pineapple was brought into Hawaii from Jamaica in 1880 and first canned in 1892. The oldest existing pineapple cannery was started in 1901.

The pineapple canners have complete control on growing and harvesting of fruit as they own the land on which the fruit is grown. One of the large canners owns 30,000 acres. The average yield of pineapple per acre in Hawaii is 28 tons and goes up to 42 tons against 5 to 6 tons in India. As many as 17,000 slips are planted per acre for growing the fruit against 4,500 to 5,000 suckers in India.

The Pineapple Research Institute, set up by the canners, has made valuable contributions towards improving the quality of the fruit, controlling the diseases and working out a detailed fertilizer and chemical treatment programmes for control of maturity, size and physiological disorders. Most of the bulletins issued by this organisation are confidential. As a result of the work of this Institute, it has been possible to develop pineapples which are quite cylindrical in shape to minimize the waste during processing. The prepared fruit yield is as follows :

1. Prime (slices, cubes, wedges) 18 to 20% (can go up to 23%)
2. Crushed pineapple 9 to 11%
3. Juice 28 to 35%
4. 40 to 45% goes to by-products

During the peak season the prepared fruit yield goes above 60% when the fruit is of the desired size (5 lbs. without crown and core). It drops to 55% during certain parts of the season and can go as low as 45% for a very short period when the fruit is so small that a large percentage is used for the manufacture of sugar syrup only.

The cut-out syrup standards for different grades of pineapple pack are as follows :

Fancy	24% Sugar
Choice	20% Sugar
Standard	18% Sugar

The sugar content of the juice varies between 12 and 14% during the warm weather conditions and the acidity is around 0.65%. During the cooler part of the year the sugar content varies between 18 and 20% and the acidity is around 1.5%.

The sugar and acid contents of the juice in Hawaii are not adjusted to any standard and the juice is packed in its natural form. There is, however, a strong feeling on the part of technologists working in the industry that the sugar-acid ratio must be adjusted to make the product more uniform in flavour for consumer acceptance.

The pineapple industry manufactures the following products:

1. Canned fruit including slices, wedges, cubes, titbits and crushed pineapple;
2. Pineapple juice;
3. Sugar from skin, ends, small fruits and odd pieces;
4. Concentrated pineapple juice; and
5. Animal feed from waste.

1. *Harvesting and Transport* : The mature fruit is harvested manually and placed on boom conveyors attached to a large specially designed truck. It is taken to the truck and placed in large bins which are loaded on the transport trucks which carry them to the canneries. The maximum distance which the fruit has to be transported from the field to the factory is sixty miles.

2. *Production of Slices* : As soon as the pineapples are received they are mechanically graded into the following sizes :

1. Large	diameter over $5\frac{1}{8}$"
2. Medium	diameter between $4\frac{1}{2}$ and $5\frac{1}{8}$"
3. Small	diameter between $3\frac{1}{2}$ and $4\frac{1}{2}$"
4. By-products grade	diameter below $3\frac{1}{2}$"

The first three grades are used for canning and the last one is used for manufacture of sugar syrup. Fifty per cent of the sugar requirements of the pineapple industry are recovered from the waste.

The canning grade fruits are washed and graded again. Then they are fed into the Ginaca machines, which are adjusted to take only one grade of fruit. These machines form the nerve-centre of the pineapple industry and were developed by Henry Ginaca, an engineer in the Dole Pineapple Corporation, in 1913. Each machine handles 105 fruits per minute. It was interesting to note that a machine manufactured in 1919 is still in perfect operating condition. This speaks of the maintenance. The machine sizes the fruit, i.e. cuts the pineapple cylinder, cuts off the end portions, removes the core and eradicates the skin.

The pineapple cylinders are placed on inspection belts and sent to women workers who trim them to remove left-over skin portions, eyes and blemishes. The fruit is then sliced on a multiple blade slicer and sent over another inspection belt where the women workers place them into cans. Three different diameter cans are normally used, namely, 401, 307 and 301.

Syrup of the desired strength is then added by means of automatic rotary syrupers. The strength of the syrup is adjusted to suit the natural sugar content of the fruit. Citric acid is not added to the syrup. The cans are then sealed on machines having steam jets for obtaining the vacuum as exhausting is not carried out. The speed of the seamer is 400 cans a minute. Angelus double seamers with steam jet arrangements for obtaining the vacuum are preferred. The plant engineers feel that these are easier to maintain and are quite satisfactory although the rollers in this seamer remain stationary while the cans rotate.

After that the cans are processed in continuous pressure cookers so that their centre temperature reaches 195°F. This type of cookers use less steam than atmospheric cookers and provide better control. Also, the working conditions improve as there is little free steam in the plant. The cooking time for 401 cans is 20 minutes at 220°F and 18 minutes for 307 cans.

The cans are immediately cooled to around 100°F in the continuous coolers and sent to the store. The rest of the storage operations are the same as described under warehousing.

3. *Pineapple Cubes, Wedges and Titbits* : Broken slices are mainly used for the preparation of these products. Simple but efficient semi-automatic equipment is used for the cutting of wedges and cubes. It should not be difficult to manufacture such equipment in India. These products are filled into the cans, syrup is added and the cans are sealed and processed in exactly the same manner as the slices. The only difference is that an additional size of smaller container is sometimes used.

4. *Juice* : Eradicated portion of the pineapple flesh from the Ginaca machines, cores and some odd pieces are pressed in a continuous screw press and the extracted juice is passed through Westphalia centrifuges which separate the heavy crude fibre and the light portion of the juice containing eyes from the main body of the juice. The juice is then flash pasteurised at 170°F and filled into pre-sterilised cans. The cans are processed at 190°F for 10 minutes. In some cases the juice is filled into the cans at 190° to 195°F which are sealed and inverted. They are not processed any further.

5. *Frozen Concentrate* : The pineapple juice is concentrated under vacuum to 61° brix. The esters are recovered in a specially made trap on the evaporation and added back to the concentrate. There is no cut-back system followed. The concentrate is then filled in 202 cans and frozen. It is also packed for bulk sales in polyethylene bags, which are packed in heavy cardboard cartons.

6. *Sugar Syrup* : Skin portion from the Ginaca machine, small fruits which are uneconomical for making other products, odd pieces and trimmings are pressed three times in a continuous screw press. Steam is injected during the second and third pressings. Thus 27% of the material is extracted in the

form of juice, containing about 8% sugar. This juice is then filtered and passed through anion and cation exchangers which convert it into invert sugar syrup. The anion exchanger is regenerated by use of ammonia and cation by use of sulphuric acid. The syrup is concentrated to the desired strength. During the fruit processing season the concentration is limited to around 20° to 33° brix. Liquid or crystalline sucrose is added to this for making syrup of the desired strength for use as the canning medium. During off-season, the juice is concentrated to above 60° brix and stored for future use. One Honolulu cannery recovers approximately 6,000 tons of sugar every year in this manner from pineapple waste. The price of sugar in Hawaii is $ 0.085 per lb. (Re. 0.40).

7. *Animal Feed* : Wastes after extraction of potable juice and the peel juice for the manufacture of syrup are mixed with 5 to 10% molasses and then dried in a rotary drier using hot air blast. These driers are oil fired. In this manner large quantity of animal feed having the following composition is manufactured : crude protein not less than 3%; crude fat not less than 0.4%; fibre not less than 19.5%; and ash not less than 5.5%.

The animal feed is sold at $ 2.60 per bag of 100 pounds.

Besides bringing additional income to the pineapple industry the manufacture of animal feed has solved the major problem of waste disposal on which the canneries had to spend large amounts of money.

B. Canning of Peas

Pea processing was studied only in Denmark. It is interesting to note that most of the modernisation in plant and machinery has taken place only since the last war. In view of this the development in Denmark is of special interest to India. India is at a stage where the Danish experience would be of immense value. It was necessary for a number of plant operations in Denmark to make a clean break with the past traditional barriers in their interest of advancement to meet world competition and adopt modern productivity techniques for placing the industry on a new foundation.

The pea growing areas are located within a radius of about 15 miles of the plant. The canneries pay growers not only according to the quantity of supply but also on the basis of the maturity of the peas, which is the main quality factor. Eleven different varieties of peas are grown. Some of these are early and others late. This helps to prolong the processing season. The total peas processing season lasts about five weeks.

Pea vines are harvested according to the production plan prepared by the processors and the deliveries are organised so systematically that there is no accumulation of raw material at the plant. For maintaining natural flavour and high sugar content it is necessary that the peas should be in the can within three hours of harvesting. One of the plants reported that they had the peas in the cans within 55 minutes of harvesting.

Pea vines are brought by trucks to the cannery and dumped on the delivery floors. From there tractors with special attachments pick up the vines and feed them on to the elevators, which, in turn, take them to the viners. The viners were manufactured by Chisholm Ryder Company in the USA and also by the International Machinery Company in Europe. One of the processors had made his own viners. The capacity of each viner is seven tons of vines per hour. In one of the plants six such viners were being used, to give 21,000 kg. of shelled peas per hour. It is estimated that one per cent of the peas are lost in the viners during dry weather but the loss goes up to 10% during wet weather as the efficiency of the viners is reduced due to high moisture on the vines which begin to slip. Considering the capacity of the viners it should be possible for some of the manufacturers in India to use one or two of these machines during their peak season. The price of a pea viner is approximately 40,000 Kroners (1 Kroner=Re. 0.69).

Aftet vining, the peas are washed and all the extraneous material is removed. Then they are graded for maturity, through a

battery of floatation graders. The brine used for determining the specific gravity (maturity) of the peas is about 10 to 11%. The concentration of the brine is automatically regulated. The total pea grading capacity of the plant visited is 20 tons per hour. The peas are then automatically blanched at 99°C for two minutes and cooled to 10°C, in less than half a minute. After that they are graded for size and then inspected on belts. The samples of peas are collected from the line at regular intervals and their maturity tested with I. M. C. tenderometers. Two sizes of peas are generally canned : (1) 7½ mm diameter and (2) 7½ to 8.2 mm. The price of poor quality peas can be as low as 1/10 of the best quality peas but the price of the finished product does not vary more than 10%.

Another plant pays the growers on the basis of the following grades.

1. Small 8.25 mm @ 0.85 Kroner per Kg. of shelled peas;
2. Medium 8.25 mm to 9.00 mm @ 0.55 Kroner per Kg. of shelled peas; and
3. Large 9.00 mm & above @ 0.42 Kroner per Kg. of shelled peas.

Peas of each grade are filled into containers on separate lines, using semi-automatic rotary fillers. After that, brine containing 2% of salt and 2% of sugar is added and the cans are sealed without exhaust on seamers at a speed of about 200 cans a minute. Steam jets are used for obtaining vacuum up to 5". The 1 lb. cans are processed for 20 minutes at 120°C (252°F) in continuous automatic pressure cookers and then automatically cooled to about 40°C.

It is also interesting to note that the efficiency of the workers is quite high. They are paid on piece work basis. Extensive studies have been carried out to determine the work-loads for various operations and to provide adequate incentives for efficiency. For this purpose, the Bidault system is used.

The canners report that it is economical to use printed cans when the production of a brand is over 150,000 cans a day.

C. Canning & Freezing of Beans

A special variety of stringless *Blue Lake* beans has been developed for canning in the USA. There are several strains which vary in their yield, quality, size, etc. Some of them mature a little early while others a little late. This helps to lengthen the processing season. The bean packing season lasts for about two months starting from the second week of July. During this period large quantity of beans are packed. One of the plants visited by the Team was packing up to 60,000 cases a day in three shifts, working seven days a week on ten packing lines. It takes half an hour to transport the beans from the field to the plant and another hour at the factory until they are sealed in the can. Thus there is little room for deterioration of the raw material quality.

Bulk handling of beans in large 1,000 lb. wooden bins is quite common. As soon as the full bins are received a random sample is drawn and the beans are graded into different sizes. Payment is made according to the maturity, which is determined by the size of the beans

The large bins are placed on a platform with prongs which tilts and drops the beans into the washing machine. After that the beans are elevated to a belt conveyor which takes them to the rotary graders. One of the two plants visited by the Team graded them into six sizes while the other into five.

After the size grading, the beans are conveyed to the revolving snippers where the ends of the beans are cut off. Then they are passed on by means of another conveyor to the bean cutting machines. These machines are adjusted to cut the beans to the desired sizes usually 1 to 1½ inches. After that they are passed over to the graders where the small and irregular pieces are separated. In one of the plants the larger cuts are returned to the cutter again. Some beans are also cut longitudinaily. This is considered to be a speciality pack and is known as French style cut. Then the cut beans are automatically blanched at 190°F for one minute to inactivate the enzymes.

This also serves the purpose of washing the beans a second time. Hot beans are filled into cans using automatic or semi-automatic rotary fillers; some canners prefer to cool the beans in running water immediately after blanching. Then the cans are filled with hot water at 180° to 185° after which a measured amount of salt is put into each can automatically in the form of tablets or crystals to give a total salt content as if a 2½% brine has been used. One very interesting phenomenon was observed that unless the bean cans are held for 15 minutes after filling and allowed to cool the skin of the beans came off on adding hot water and salt. Therefore, in one of the canneries, a long overhead line was being used to delay the containers for 15 minutes by making them travel over sufficient distance until they reached the seamers. The cans are vacuum sealed on fast seamers operating at a speed of about 350 to 400 cans a minute. A steam jet is used during seaming to remove air from the head space. The exhausting of filled cans is not practised in most of the canning plants. The steam jet seaming gives 8" to 10" of vacuum per square inch. In one of the newer plants, the seaming speed is much higher. Usually 6 to 10 lines are used, depending on the output desired. This indicates that it may be possible to introduce a similar one line operation in India for a few products. Continuous pressure cookers are used in most of the vegetable canning plants. Stationary cookers, however, are used for processing No. 10 cans. The most popular can for packing vegetables in the USA is 303 × 406 having a net content of 17 ozs. The same container is also used for packing peas in Denmark.

The continuous cookers operate at a speed ranging between 178 to 360 cans a minute depending upon the size of the container. The newer cookers have a larger capacity. Continuous coolers are attached to the cookers and the cans travel directly into them after coming out of the cookers. The cans are usually cooled to about 100°F to 110°F. This permits quick drying of the cans as they roll on the conveyors to the warehouse.

The processing times and temperatures followed in almost all the vegetable canning plants are those laid down by the National Canners' Association in their Bulletin No. 26-L. This publication is available on request. In some States, such as California and Oregon, State Governments enforce the processing time and temperature for vegetable processing but these also are the same as those recommended by the National Canners' Association. The recording charts from the automatic controls used on the cookers are filed regularly and are checked by the State Inspectors.

Wherever the canner uses his own labels or has a definite order to supply under some other label, the cans are passed through the labelling machines which operate at speeds varying from 400 to 600 cans a minute. The cans are also stored without labels. In the smaller canneries, the cans are manually filled into the cardboard cartons or cases and then sealed. In modern plants, the cases are filled, glued and sealed automatically. These are then carried to the warehouse by fork-lift trucks and stacked on pallets in inter-locking positions.

It may not be possible for us in India to adopt all these techniques requiring automatic equipment warranted by the size of production in the USA but the introduction of labelling machines and the use of cardboard cartons will make a valuable contribution towards increasing the production efficiency. First of all, storage of empty cartons will save considerable amount of space. Secondly, these can be filled with much greater efficiency and their light weight will save on freight. Cardboard cartons can be introduced only if they can be obtained at reasonable prices. Depending upon the size of the cartons, they are available in the USA for 12 to 16 cents each i.e., 60 to 80 nP each. The American cartons have a bursting strength of about 250 lbs. per square inch and are strong enough to withstand transport by trucks and railways. This also emphasises the need for improving the quality of cardboard cartons in India in addition to making them available at reasonable prices. They cost about three times as much in India at present and their quality is poor. Sources of wood for

making cases are very limited in India and, therefore, it is very necessary to utilise cardboard for packaging.

Freezing of Beans: Beans for freezing are handled in exactly the same manner as those for canning up to the stage of blanching. The beans meant for freezing are blanched at 190°F for two minutes to make sure that the enzymes are sufficiently inactivated and cannot become active on thawing. Large size beans which are at a higher level of maturity are usually not considered fit for freezing.

The frozen beans are filled automatically into 1 lb. and 2½ lb. waxed cardboard cartons. The cartons are arranged on trays, placed on trolleys, and frozen in a blast tunnel at —30° to —35°F. After the beans are frozen they are removed from the freezer and packed in cardboard cases which are stored at —5° to —10°F.

Romano beans and broad beans are also frozen in the same manner as the *Blue Lake* beans.

The sale of canned and frozen beans has been steadily rising in the USA over the last few years and is expected to reach the same level as that of the green peas.

D. Canning of Corn

The average yield of corn per acre in Hoopeston, Illinois, in the USA is 3.3 tons and can go up to 5 tons. The price paid to the farmer per ton on delivery at the factory is on an average $ 21.00 for yellow corn and $ 20.00 for white corn. It, however, varies from year to year. One year it was $70.00 per ton, which was abnormally high, while the next year it was very low. The corn is harvested when the moisture content is 70 to 72% for packing of whole corn. For packing of cream style corn, the moisture content of the corn should be 65%. Succulometer is used to determine the moisture content.

Two types of corn packs are prepared in the USA: (1) cream style and (2) whole kernel.

At present very little corn is packed in India but it is quite possible that in the near future the size of this pack may increase and the information collected may be useful to the canners.

The corn season in the State of Illinois, where the Team spent two days studying this industry, lasts about four weeks. The production of one of the canneries visited is 40,000 cases a day of 36 cans (303 × 406) having a net weight of 17 ozs. each.

The corn is received and dumped on an elevator which takes it to the huskers, where the husk and the remaining portion of the stem are removed. These machines are fed manually and the labour is paid on a piece work basis. After that the corn is washed in a rotary washer which serves the dual purpose of washing and silking. Then it is passed through cutters which separate kernels from the cobs. Each cutter has a capacity of about 100 corns a minute. It should be possible for Indian manufacturers to use one or two such cutters. In America, a large number of such cutters are used in every corn canning and freezing plant.

When whole corn kernels are to be packed they are washed and cleaned to remove any husk or coarse particles left over from the cob. After that they are blanched at 195° to 200°F for three minutes. Then, water, sugar and salt are added automatically and the cans are sealed at a speed of 250 to 300 a minute. Steam jets are used in the seamer to remove air from the head space for obtaining seven to eight inches of vacuum. The cans are then processed in continuous or stationary cookers depending upon the speed of production desired and the preference of the canner.

For preparation of cream style corn the kernels are first crushed to the desired degree and then cooked with starch, salt and sugar. One of the canners used the following formula:

1. 28 gallons of brine (made up by mixing 700 lbs. of sugar and 144 lbs. of salt).
2. 172 gallons of crushed corn; and

3. 12 lbs. of starch.

Total 200 gallons batch.

The whole mixture is then filled in 303×406 cans or in small 8 oz. cans. The canners prefer to process the cans in stationary retorts as they claim that the flavour retention is better as compared to the corn cooked in continuous retorts.

The processing times and temperatures for different sizes of corn cans are as recommended bythe National Canners' Association in their Bulletin No. 26-L. The corn canners seem to prefer multi-storeyed buildings where each stage of preparation, such as husking, washing and cutting is carried out on defferent floors. The final filling, cooking and storage are on the ground floor.

The canners expect shelf life of the corn to be around three years.

One of the corn canners reported that as a result of a programme of operational studies carried out in his plant and consequent improvements brought about in machine utilisation, his plant was operating at 117 per cent efficiency level.

54.93 lbs. of green corn is required per case.

600,000 cases of corn are packed at the plant every year.

The percentage of wastage in the manufacture of canned corn is 75. The cost of transporting the waste is recovered by selling it for making silage for cattle feed.

E. Manufacture of Tomato Products

One of the largest fruit processing plants in California, USA, is located in an area where 85% of the tomatoes in the State are grown. This makes it possible for the plant to obtain the best possible quality of raw material for manufacture of high quality products. Tomatoes are grown under the direct supervision of the field staff of the plant who determine the variety to be grown, fertilisers and pesticides to be used and also the time of harvesting. The factory has signed contracts with the growers to supply tomatoes grown on 100,000 acres of land. All the tomato supplies for the plant come from within a radius of 25 miles. The area grows a total of 2,800,000 tons of tomatoes. The average yield of tomatoes per acre is between 20 to 22 tons. The tomato season lasts from August 1 to the middle of November. The price is $ 27.50 per ton to which an average of $ 3.00 per ton is added as freight and handling charges. Over the last ten years the price of tomatoes has varied between $ 20 and $ 30 a ton. Tomatoes are picked three times during the season. Picking charges are between $ 7.00 and $ 8.00 per ton.

It is significant to note that over the last three or four years new varieties had replaced the old ones completely. The most popular variety at present is *Pearson* and its various strains which are known by the number given to them. Also a number of new Italian, pear shaped, tomatoes have been introduced.

The average soluble solid content of tomatoes is 6% and the acidity is between 0.27 and 0.57%. Early tomatoes have low acidity and the late ones high. This is primarily because watering is stopped after the tomatoes reach maturity. Before the processors accept the supplies of tomatoes they go through state inspection for colour, mould count and other defects. The processor has the right to reject the tomatoes which cannot make good products but this does not happen often. The most common varieties grown for canning of peeled tomatoes and manufacture of juice are VF-36 and C-32. These varieties are also very suitable for manufacture of tomato ketchup.

The juice yield is 90% to 95%. It was stated that 75% of the cost of finished product consists of ingredients including raw materials and packing and only 25% goes for labour, marketing, transport, overheads, etc.

The glass containers, cases and closures used by the processor come from a distance of 40 to 50 miles.

The spice extracts and vinegar used in the manufacture of tomato ketchup are made by the manufacturer.

The steps involved in preparation of tomato products are as follows :

1. The lug boxes containing tomatoes are automatically emptied into water tanks and washed in rotary washers.

2. As the tomatoes come off into a tank at the end of the washer they are conveyed in water flumes to the plant and delivered on an inspection conveyor, which has rotating rollers.

3. The conveyor rollers keep the tomatoes constantly turning so that the workers can inspect them for any defects.

4. The tomatoes are then passed through a screw press which has steaming arrangement. The juice comes off in a trough and is pumped into storage tanks. The waste is run through a 0.32 inch screen and the liquid portion is drained off into the sewage, which takes it to the reduction beds in the field. The solid portion of the waste is sent to the garbage dump by truck. A portion of the juice, after addition of the required amount of salt, is canned and another portion is concentrated and made into tomato puree or used for the manufacture of tomato ketchup. Although the company manufactures a large quantity of peeled tomatoes, the operation was not in progress at the time of the Team's visit.

The manufacture of tomato ketchup was also not seen by the Team but it was mentioned that strict control is maintained on the following factors in the manufacture of tomato ketchup :

(1) Total solids, (2) soluble solids, (3) acidity, (4) sugar, (5) colour—addition of artificial colour is not permitted, (6) flavour—organoleptic test, (7) microbial control, and (8) insect fragments.

The tomato ketchup filling units at the plant operate at a speed of 600 bottles a minute.

The plant had the capacity to use 1,000 tons of raw material per day.

Most of the machinery used in the plant was purchased from the machinery manufacturers but perfection was carried out by the processors' own engineers.

The organisation had a continuous operational research and work study programme of its own which helped to increase efficiency considerably.

In Denmark, tomato ketchup is manufactured from puree containing 30% soluble solids imported from Yugoslavia in 5 Kg. cans. Water, sugar, salt, colour and preservatives are added to the puree simultaneously with heating in a pan. Spice extracts and vinegar are added at the end.

The finished ketchup having 28% soluble solids is packed in 300 gram plastic containers and 450 gram bottles. The price of both the type of empty containers is 0.29 Kroners each (Re. 1=0.689 Kr.). Three hundred gram ketchup re-fillers are also sold in polyethylene plastic bags.

Storage of ketchup in plastic containers results in loss of flavour after three months but the containers are very attractive and have consumer preference because of the convenience of use on the table.

F. Packing & Processing of Citrus Fruits

The Team visited the largest co-operative organisation of fruit growers on the west coast of the United States. The 9,700 members of the co-operative grow approximately 70% of the citrus fruits in that area. The average land holding of the co-operative per member is 16½ acres but some of the members own as much as 1,000 acres.

Valencia and *Washington Naval* are the two main varieties of oranges grown. A large portion of the lemons grown in the area belong to the *Eureka* and West Indian varieties. Fairly large number of grapefruits are also grown, seedless marsh being the most popular variety. Small quantities of Tangerines and Mandains are also grown in some parts of California. The Japanese *Satsuma* variety is now being introduced in some areas.

The researches carried out in the co-operative's own Research Department and

in collaboration with the State Experimental Stations have made valuable contributions in improving the quality of raw material. At present the average yield of oranges per acre is 250 field boxes (each box contains 55 lbs. of fruit). The maximum yield goes up to 700 field boxes per acre. In case of lemons, the average yield is 350 field boxes and goes up to a maximum of 1,000 field boxes per acre.

The co-operative is a well-knit orgainsation with its own field staff, packing houses, processing factories, research department and a growers' supply company.

The growers under an agreement with the co-operative are obliged to supply their entire fruit crop to the packing houses, which grade, select and pack fresh fruits. Eighty per cent of the *Washington Naval* oranges and 65% of the *Valencia* oranges are marketed fresh. About 50% of the lemons grown are also packed for the fresh market. The crop estimate for 1962 was :

Lemons	...	180,000 tons
Orange	...	170,000 tons
Grapefruit	...	10,000 tons

Fruits not packed for the fresh market are supplied to the processing factories for manufacture of various products.

The packing houses paid the following prices per ton to the growers in 1961.

Valencia Orange	...	$ 50.00 to $ 60.00
Naval	...	$ 30.00
Grapefruit	...	$ 20.00
Lemons	...	$ 35.00 to $ 40.00

It has been possible by proper scientific control to increase the yield of juice from oranges by 20 per cent over the last ten years.

The Research Department has also made a very valuable contribution in developing a number of new processed products from oranges. According to the information given to the Team the co-operative manufactures approximately 300 processed products.

The orange growers' supply company looks after the fertiliser and pesticide requirements of the members and also manufactures 20% of the requirements of cases for the packing houses.

Packing of fresh oranges, grapefruits and lemons : Citrus growers have 120 packing houses. The Team visited two such units, one for grapefruits and oranges and another for lemons.

The orange packing house was originally constructed in 1914 but it has gone through a number of alterations from time to time to meet the capacity and to raise productivity.

The various steps involved in packing of fresh fruits are as follows :

(a) The fruit is transported in specially designed truck trailers with horizontal and vertical compartments so that the fruit is not damaged due to heavy stack load. The total load which the trailers can carry is 20 to 30 tons. As soon as the truck arrives at the plant, it is weighed. The tare is deducted after it is emptied.

(b) The emptying of truck is very efficient. The vehicle is parked on a platform at an angle of 13° and the unloading gates on one side of the truck trailer are opened. The oranges roll on to a conveyor and are either carried to storage bins or straight into the packing plant.

(c) The fruit is automatically washed with a mixture of detergents, mainly consisting of quaternary ammonium compounds, a small amount of lye and some fungicides. The washer gives a good scrubbing with the brushes to the fruit.

(d) The fruit is next sent to the coating chamber where liquid wax is sprayed on it.

(e) Then it is passed through a blast of hot air, which dries the wax.

(f) The fruit is then graded manually for quality by trained workers, who mainly look for blemishes and other surface defects.

(g) As the workers drop the fruit into a chute it is counted by an electronic device and the grade is mechanically stamped on it.

(h) Then it is size-graded mechanically and supplied on conveyors for filling. The workers inspect the fruit at this stage just as it automatically drops into the telescopic cardboard cartons or wooden cases. These containers are designed to hold about 37 lbs. of fruit. The cost of a telescopic cardboard carton is 26 cents and that of a wooden case about 45 cents.

The best "fancy" grade is stamped by the co-operative under its own trade mark. The next grade is stamped "choice" and the third "standard". The fourth sub-standard grade is collected in bulk and sent to the processing plant.

(i) The packed fruit boxes are stored at 45° to 50°F. At this temperature, they can be kept for a period of two months and can be transported over long distances.

The process for packing of grapefruits and lemons is similar to that for packing of oranges. The only difference in the packing of lemons is that they are picked green according to the size and not according to maturity. Therefore, it becomes necessary to store them at 58°F and 90% humidity for a period of three weeks to four months (after giving a coat of wax) until they change colour.

After that they are washed, re-waxed, graded for size and packed. The grade marking machine used for lemons is more modern and has a much higher capacity. It has been designed by the research department of the co-operative.

The capacity of the orange packing plant visited by the Team is 900 railway wagons a year (each wagon holds 9,600 cartons of about 35 to 40 lbs.). The grapefruit packing line has a capacity of 200 wagons and the lemon packing line a capacity of 1,200 railway wagons a year. These plants are designed to operate at about 20 to 25% higher capacity to meet the increasing demand.

The average marketing expenses amount to 5%. One per cent allowance is made for breakage, damage and loss. Freight charges are $ 1.75 to $ 2.00 per Cwt. for a distance of 3,000 miles from coast to coast. In addition to this, a small refrigeration surcharge is paid. Auditing (accounting & billing) expenses amount to 2% and advertisement 1%.

The prevailing prices of citrus fruits packed in cardboard boxes are as follows :

1. Grapefruit	Fancy pack	$2.25	per box of 35 to 40 lbs.
	Choice	$1.75	,,
2. Orange	Fancy pack	$4.00	,,
	Choice	$2.25	,,
3. Lemon	Fancy pack	$6.00	,,
	Choice	$3.50	,,

Manufacture of Juice : Under an agreement, the packing houses must supply the entire quantity of fruit not used for packing fresh, mainly undergrade, to the processing plants for manufacture of various products. This amounts to only 25 to 30% of the total fruit supplies received by the packing houses. On these supplies they realise about half the price as compared to that of the fruit sold fresh.

The co-operative has one orange processing plant and one lemon processing plant. The Team visited only the former.

The steps involved in processing of oranges are as follows :

(a) The fruit is received in 20 to 30 tons truck-load at the processing plant.

(b) It is weighed and the vehicle is parked next to a platform at an angle of 13°. The gates on one side of the trailer are opened and the fruit is allowed to roll down to a conveyor, which takes it to the large storage bins located outside the plant in an open area.

Samples are drawn automatically from each truck-load and examined for the total juice content and the sugar-acid ratio. The average sugar-acid ratio is 10.7: 1 and the average juice yield is 53-54%. The determination of sugar-acid ratio helps the production department to decide on the products which could be most advantageously manufactured out of it.

The packing houses are paid on the basis of the juice content of the fruit.

(c) The fruit is supplied from the large storage bins to the factory on conveyor belts. These belts are constantly sprayed with water containing five parts per million of free chlorine to prevent formation of slime. The production department can control the speed of all the supply belts from inside the plant to regulate the fruit supply.

(d) The fruit is automatically washed with water containing qokite, size graded and sent on conveyor belts to the rotary juice extracting machines (manufactured by Brown Citrus Machinery Company). Four different sizes of machines are used to suit the four sizes of fruits. The machines have a number of rosettes or burrs on it. As the fruit enters the machine it is cut into half and picked up by cups which automatically press them on to the burrs. The juice which comes out is strained through stainless steel screens (0.020 mesh). Another type of juice extraction machine with vacuum suction tube is also being used very successfully. A sharp tube (about 5/8" diameter) with perforations on the sides pierces the fruit as it is supplied and sucks out the juice by vacuum. The juice from this machine has less bitterness but the yield is not as good. Also this machine can take all sizes of fruits without grading. The juice coming out from the different machines is mixed together and passed through centrifuges to remove coarse material. It is then deaerated and pasteurised at 202°F for 15 seconds using plate pasteurisers, filled in cans at about 160°F and processed for 10 minutes at 190°F. The speed of the filling machine is about 175 cans per minute. The 5½ oz. printed cans are filled at 175°F, sealed and inverted and then allowed to cool in air as they travel to the warehouse on a conveyor. Only citrus enamelled cans are used for packing the juice in California but plain cans are preferred in Florida.

The juice meant for freezing is pasteurised at 160°F for 15 seconds to inactivate the enzymes, and is concentrated under 29" vacuum in Mojonnier triple effect concentration units. The concentration is normally carried on until the juice reaches 58° brix and then it is cut back with single strength juice to 42° brix. The concentrate is filled at 32°-34°F in small 5½ oz. consumer-size containers for direct marketing and in bulk containers for sale to manufacturers of orange drink. It is then frozen at —48°F.

The maximum capacity of the processing plant is 14,000 tons of oranges a week but the average production over the entire season is 7,000 tons a week. The high manufacturing capacity is maintained to take care of the surplus during the peak season

By-products : The important by-products manufactured from citrus fruits are :

(a) Pectin,

(b) Citrus oil,

(c) Bioflavanoids, and

(d) Cattle feed.

Manufacture of Pectin : Pectin is a very important by-product of the citrus industry. The Team visited two pectin manufacturing plants, one in Denmark and the other in the USA. The Danish plant imports dried orange peels for manufacturing pectin, most of which is exported. The plant in the USA uses orange peel waste which is left over after manufacture of juice and oil.

The various steps involved in its manufacture are as follows :

1. pH of crushed citrus peels after extraction of oil is adjusted to 2.5.

2. The mass is cooked at 180°—210°F for 40 to 45 minutes.

3. The cooked material is filtered through a rotary drum filter using paper lining.

4. The filtrate is mixed with the diatomaceous earth and passed through another filter. This filtrate transmits about 80 per cent light.

5. The filtrate is concentrated 3 : 1 in a forced circulation evaporator so that the pectin content of the extract is at least 3 per cent.

The maximum temperature attained during the concentration is 150°F. The rate of evaporation in the concentrator is 360 gallons of water per hour.

6. The concentrated liquid is run into a tank containing 80% isopropyl alcohol until the proportion of alcohol to the pectinaceous extract is 2 : 1. This results in almost complete precipitation of the pectin.

7. The precipitate is washed three times. The first wash is given with alcohol containing hydrochloric acid (pH 1). The second wash is only with the alcohol and the third wash is with alcohol buffered with ammonia (pH 5).

8. The washed precipitate is pressed in a hydraulic press.

9. It is dried in cabinet drier to 2 per cent moisture level.

10. The dried pectin is ground to 60 mesh.

11. It is finally packed in polyethylene lined cardboard boxes with metal ends.

During the preparation of pectin, the methoxyl content is carefully maintained by not raising the temperature too high. The methoxyl content of lemon pectin is 12 and that of orange pectin 10.

Over 95% of the alcohol used for precipitation is recovered from the mixture by distillation.

Cattle Feed from Waste : After extraction of pectin the remaining waste is steamed, pressed and then dried in oil fired drum driers using direct heat. The coarse powder is packed in 100 lbs. jute bags and sold as cattle feed.

The newly developed techniques for the extraction of orange oil and manufacture of flavanoids are kept secret.

G. Packing of Mandarin Orange Segments in Japan

The only way to make a real success of packing Mandarin orange segments is to have the right variety of seedless Mandarin oranges. Japan has very successfully developed for this purpose the Unshiu strain of the Sutsuma Mandarin oranges.

For growing this variety the root stock used is that of Trifoliate orange. This variety of orange is very sensitive to weather condition and, therefore, grows only in one limited area in Shimzu Prefecture. The optimum suitable temperature is 16°C. The temperature in growing areas goes down to —5°C in winter and to a maximum of 33°C in summer. It is very necessary to attain the minimum temperature to ensure healthy growth of the plant.

The rainfall in the area is 2200 mm. It is spread over ten months of the year. There is no rainfall in July and August, and, therefore, the plants need irrigation during this period. The number of plants per hectre is 500 and the distance between plant to plant is four metres on all sides.

The fertilisers used are two tons of ammonium sulphate, 1½ tons of calcium phosphate and one ton of potassium sulphate per hectre in five applications. Forty per cent of the fertiliser is used in spring, 30% in summer and 30% in autumn. The harvesting season for the Mandarin oranges in Japan is from the first week of November to the last week of March.

The main diseases which affect the Mandarin oranges are : (1) Anthracnose, (2) Brown rot, (3) Canker, (4) Melanose.

Of a total export of 4,743,402 cases of canned fruits, Mandarin oranges alone account for 4,215,338 cases. The Japanese Government gives a grant of 30,000 yens (Re. 1=75 yens) per ton to the exporters of canned foods. This subsidy makes it possible for them to export the products in spite of the high cost of some raw materials, particularly the tin plate. The price of 100 eleven oz. cans in Japan is 1,600 yens.

Canning of Segments : As the Mandarin orange season had not begun at the time of the visit in September it was not possible to see the actual canning of segments. The equipment used for the purpose was, however, seen and the processing techniques

were discussed with the production staff. As a result of this, it was quite clear that the basic principles followed for canning of Mandarin orange segments in Japan are similar to those followed in India except for three important factors. First, the quality of raw material is much superior as it has been specially developed for the purpose. Secondly, the operation in Japan is considerably more efficient and the segments of the seedless oranges do not break because of the use of coveyor belts and good organisation of processing line. Thirdly, the cans are processed at 190°F in a well designed compact continuous atmospheric cooker. This cooker consists of a long tank filled with hot water and has two chains at either sides connected by steel rods. The rods move in a straight line through hot water. The cans are placed against the moving rods and roll through the tank as they are pushed. Because of this type of processing, the cooking time required is only ten minutes. As the cans come out of the processing tank, they are immediately cooled in a continuous cooler designed along the same pattern as the cooker. Then they are labelled and 48 cans are packed per cardboard carton. Some orange segments are also packed in large No. 10 cans for institutional use.

Wages paid to the cannery workers vary from 10,000 to 20,000 yens per month. It was noted that the productivity and quality consciousness in Japan is growing very fast and the canneries are going through a number of alterations so that more modern techniques can be introduced and sanitary conditions improved.

H. Brining of Cherries

The Team visited one of the largest cherry brining plants in Oregon, USA. It had a capacity of handling 11,000 tons of cherries during the season of about one month. The daily deliveries to the plant were up to 100 tons. The peak supplies were around the 10th of July. The plant is a co-operative unit with a membership of 800 growers having 4,000 acres of cherry bearing plantation. The average yield per acre was 3.3 tons. The trees were planted 24′ to 60′ apart. Yield up to 1500 lbs. per tree was reported and in exceptional cases a tree had produced one short ton of cherries in a season.

The varieties of cherries grown in the state of Oregon are :

1. Royal Anne (principal supply),
2. Water House,
3. Lambert,
4. Hoskin,
5. Bing,
6. Black Republicans, and
7. Van.

The cherries are picked when they are mature. Special care is taken in case of the black varieties to make sure that they are picked when they are red or brown in colour. If they get fully matured it is not possible to bleach the colour.

The cherries are supplied to the plant in 30 lb. boxes. In 1962 the cherry crop was exceptionally large and, therefore, the plant was paying the growers 10 cents per lb. for Royal Anne and 8 cents per lb. for black cherries. Normally the price is 50% higher.

As soon as the cherries are received at the plant they are washed and put into large wooden tanks containing brine for bleaching and curing. The composition of the brine is 1.5% sulphur dioxide and 6 lbs. hydrated lime per 100 gallons. The plant has 90 tanks each having a capacity of 13,000 gallons. Each tank thus holds 27 tons of cherries and 6,500 gallons of brine. Liquid SO_2 is used for the brine. The sulphur dioxide content of the brine is checked every day. The brined cherries get completely bleached in about 30 days. Then they are pumped out of the tanks using rubber and plastic hoses with brass couplings. By making the cherries flow over a screen the brine is separated and pumped back into the tanks. Its strength is re-adjusted before use. This curing period of 30 days is essential before cherries are taken to the plant for pitting. Otherwise they crack. It is also essential to maintain the pH of the brine between 2.6 to 3.00 to prevent cracking. At this stage, some

cherries are also despatched to other processing plants in fur wood barrels or stainless steel railway tankers. It is essential to use the 3-1-6 stainless steel in the construction of tanks.

The barrel warehouse of the plant is very well designed to hold 4,800 barrels on racks. Nine barrels are stacked one over the other. Between every two rows of barrels walking space is provided. Electrically operated chain hoists are used for removing and replacing the barrels in the correct place. One of the new installations for storage of barrels has an escalator as the second floor is also being used for stacking of barrels. The cost of barrels is around $ 10.00 each. These are paraffin lined and are used only once for shipping but they may be used two or three times in the plant for storage of cherries.

The preparation of pitted cocktail cherries is as follows :

1. Cherries are graded for size.

2. The graded cherries are placed on a belt which takes them to a shaker.

3. The shaker breaks the clumps and sends them to a vibrator conveyor.

4. The cherries are sorted out on the vibrating conveyor.

This is a wonderful invention. The cherries travel from one end of the conveyor to the other as it vibrates. The material used for its construction is compounded aluminium which is not affected by the chemical composition of cherries or the brine. This conveyor is manufactured by M/s. Allen Fruit Company, Newberg, Oregon.

5. The vibrator conveyors deliver the cherries to an elevator which takes them to the grader. Here the cherries are graded into four sizes and dropped on to a conveyor. Each grade of cherries is separately conveyed to four Dunkley pitters. Each pitter has a capacity of 25 to 30 barrels a day.

After this the cherries are delivered to a separator which removes cherries without stems from those with stems. The cherries with stems are used for cocktail while those without stems are used in the manufacture of fruit cocktail. After this, the cherries are again delivered to a vibrating conveyor for sorting and then to an ordinary conveyor.

6. The conveyor carries the fruit to barrels with brine. They are now ready for despatch to processors who colour and pack them.

The price of cocktail cherries with stems is around $ 0.40 per lb.

I. Dehydration of Prunes

Dehydration of prunes is a fairly large industry in the USA. In Oregon, the varieties of prunes dehydrated are : Italian and Parson-sweet.

According to the growers, an yield of five tons per acre is quite common but it also goes up to ten tons. One of the growers reported that he was getting an average yield of 16 tons per acre.

The prune dehydrator visited by the Team is owned by one of the large prune growers who has a 200-acre orchard of his own. In addition to this, he obtains prunes from 56 other growers. Some of the orchards are as old as 60 years. Normally, new orchards begin to yield the crop after five years.

The drying capacity of the plant is 120 tons a day (24 hours). Last year, 1,000 tons of fresh prunes were dried to give 310 tons of dehydrated product. The prune season lasts for about 10 days.

The steps involved in dehydration of prunes are as follows :

1. The fruit is received in one ton bins;

2. Prunes are dumped on a conveyor belt which carries them inside the factory;

3. The fruit is washed;

4. The conveyor carries washed fruit to a spreading machine where wooden trays made of reepers are automatically supplied from one side and the fruit is spread on them uniformly;

5. Twentyfour trays are loaded on one trolley; and

6. The trolleys are then placed into the counter-current tunnel driers. Each tunnel

has three tracks for the trolleys and each track takes 24 trolleys.

Air is heated by oil burners using 1,500 gallons of oil per day. The hot air is circulated by means of 30 horse-power multi-wave circulators. The new counter-current tunnel dehydrators have facilities for taking 36 trolleys on each track. The dry bulb thermometer temperature at the entrance to the tunnel dehydrators is maintained at 170°F and at the other end the wet bulb temperature is 105°F to 110°F. Slight variation occurs in the latter depending upon the sugar content of the fruit which, varies from 18% to 20%. One trolley of dehydrated prunes is taken out from the discharge end of the track every hour. At this stage the moisture content of the fruit is around 19%. The dry prunes are then supplied on a screw conveyor to the packing bins where they are filled into cardboard boxes and sold to the packing houses. The packing houses adjust the moisture to the correct level and re-pack the fruit in small consumer size packets.

The price of fresh prunes is around $90.00 per ton while that of the dehydrated fruit is around $ 400.00 per ton. The expenditure involved in dehydration of the fruit per ton is as follows :

Oil	... $ 7.00	($ 3.30 per barrel of 52 American gallons or 45 Imp. gallons)
Labour and Depreciation	... $30.00	
Electricity	... $ 2.50	
Price of fresh prunes (3.1 tons)	... $ 279.00	
	$ 318.50	

The average price of dried prunes per ton works out to $310.00 while the selling price is $ 400.00. Thus the profit margin for the drying plant is approximately 4.5 cents per lb.

Some dehydrators are designed to use gas burners but their fuel cost works out to be the same as the oil fired ones.

J. Manufacture of Jam

The basic technology involved in the manufacture of jam is the same all over the world. But some interesting differences were observed in Denmark and the USA. specially in the manufacture of dietetic jams, which may be of interest to the food processing industry in India.

In Denmark most of the jam is manufactured in vacuum pans. The manufacturers claimed that this gave much better retention of colour and flavour as compared to that prepared in open pans. The vacuum concentration prevents development of any scorched or burnt flavour. A major portion of the jam manufactured in Denmark is packed in 250 and 500 gram glass jars with twist-off caps in polyethylene lined cardboard cartons. The packing of jam in cardboard cartons has many advantages. First of all, they are light in weight; secondly, there is no chance of breakage; thirdly, they are printed and do not require the use of labels; and fourthly, they are cheaper than glass. The average cost of printed 1 lb. cardboard carton is Kr. 0.18 (Kr. 1=0.69 nP). Preservation of jam in cardboard cartons, however, presents the problem of short shelf-life as they are not air tight. Therefore, the manufacturers are legally permitted to use 0.13% sodium benzoate as a preservative.

A fairly large quantity of low calorie jams are also manufactured in Denmark. The sweetening agent used is saccharine or sodium cyclamate or a mixture of the two. As the soluble solid content of these jams is not adequate for the gel formation with pectin, they use agar-agar instead. Sodium benzoate or sorbic acid is used as a preservative in these jams. Most of these jams are packed in 250 gm glass jars with twist-off caps.

In the UK and in the United States, dietetic jams of the same types are manufactured by substituting sorbitol for sugar. This provides sufficient amount of soluble solids to form gel with pectin and, therefore, the product resembles the normal sugar jam. It has greater acceptance with the consumers but is considerably more expensive. As sorbitol does not provide adequate sweetness, a small amount of sodium cyclamate is added.

The price of 250 gm empty jar with cap in Denmark is Kr. 0.18.

It was noticed in Denmark, the UK and more so in the United States that single service jam packs are finding favour with the consumer. It is necessary to use sodium benzoate as a preservative in most of these packs. All the single service containers are not moisture vapour proof and can permit the growth of mould if a preservative is not used. Several different types of single service containers were seen. Some manufacturers used hard plastic or polyethylene cups of 1 oz. capacity with printed polyethylene lids. These containers are automatically filled and closed. The other types of containers seen in the USA are either polyethylene strip packs or aluminium strip cups. In both cases, the packaging material is fed into the machine, moulded into the shape, filled and sealed automatically. Usually this type of pack is sold in cartons containing one dozen and two dozen 1 oz. containers of different types of jams. This gives the consumer a wide choice on the table to use any type of jam he would prefer instead of using the same type of jam for a long time if he purchases the normal 1 lb. jar. These single service containers are also finding favour for use by airlines, railway dining cars, hotels and restaurants.

K. Manufacture of Baby Foods and Junior Foods

The Team visited one of the largest manufacturers of strained baby foods in the USA. They have a modern multipurpose unit where they manufacture a number of food products and employ 1,400 workers during the peak season but at the time of the visit the labour strength was 850.

The steps involved in the manufacture of baby foods and junior foods are as follows :

1. Fruits such as peaches and pears are received fresh, washed and very carefully inspected. It is very essential that the microbial count at every stage is maintained very low.

2. The fruit is then peeled, cut, cored and pitted.

3. The fruit is heated to around 210°F and pulped. It is very essential that no pits should enter the pulper as otherwise they can break and make the entire pulp gritty.

4. A number of different types of strained foods are prepared. These include peach, pears, pear and pineapple and banana and pineapple. Lemon juice is added for flavour and also to adjust the pH to 3.7-3.8

5. The pulps are then filled in jars. The jars used for baby foods have 4½ oz. capacity and those used for junior foods 7½ oz. capacity. The jars are air cleaned and inspected under a large lens as they go to the filling machine to make sure that there is no dirt or crack.

6. The jars are filled at 208°F and sealed at the rate of 650 a minute. ALCO twist-off caps are used to close the containers. They are inverted and allowed to travel over a long conveyor line to the store. The jars are not sterilised. Hot filling is adequate to maintain the contents in good condition as sufficient care is taken throughout the processing operations to make sure that bacterial count is very low. Every hour samples are drawn from different places on the processing line and checked in the laboratory.

7. The vacuum in the baby food containers is around 22". If the vacuum is not adequate, the containers are automatically rejected from the line. Microbial loads are determined at different levels, such as, in raw material, in pulps at the filling stage and in the finished product. Every effort is made to minimise the heat-treatment. The processing conditions for most of the baby foods are determined in the central laboratory of the company. The quality control laboratory in the factory maintains these standards with utmost care. Normally there should not be more than two spores per 10 grams of food at the time of filling.

The samples drawn from the line are also checked for their bacterial count and are incubated at 37°F and 55°F for three days. Differential count is taken for anærobes and aerobes.

L. Processing of Fish

The Team visited seven fish processing plants, four sardine canneries, one freezing plant, one tuna cannery and one chowder manufacturing unit in the USA. Except for the chowder manufacturing unit all the other plants are located on the wharfs. Parts of these canneries are built on the water surface supported by pillars on piles. This made it convenient for the plants to receive fish. The trawlers came alongside the canneries. Waste disposal is also not a serious problem because the effluent is allowed to flow underwater at a distance of a few hundred feet through pipes. There is a considerable amount of controversy on this subject as the discharge of effluent in water reduces the biological oxygen demand and makes it difficult for the fish to live.

Canning of Sardines : Sardine packing season lasts in the State of Maine from the 15th of April to the 1st of December. The length of the season is controlled by legislation. The fish is caught by 80′ long trawlers, which have a carrying capacity of 130 to 180 bushels each. These trawlers do not transport fish usually to the canneries but larger transport boats are used to collect the fish from the trawlers at sea and take them to the canneries.

Some of the canneries own their trawlers but others prefer to work under contract with fishermen, whom they finance. The latter arrangement seems to be preferable as the fishermen look after their own boats much better and the canners do not have the problem of maintaining them.

The price of sardines at sea in 1962 was approximately $ 1.45 per bushel (72 lbs.). It varied at different periods during the season. In the beginning of the season the price was $ 1.14 but later went up to $ 1.45; to this price 15 to 20 cents must be added for transportation to the canneries. All the fishing boats are motorised and most of them have refrigeration facilities.

The transport boats bring the fish loads to the cannery. After that sea water is filled into the holds of the boat so that the ratio of water to fish is 80 : 120. This makes it possible to pump the fish into the cannery.

In the cannery, the fish is washed and chilled in 45% brine having free chlorine content of 5 p.p.m. to a temperature of 23° to 30°F. After that it is stored in large pine-wood tanks (capacity 85 to 130 bushels). Some of the canneries use steel tanks with epoxy paint.

During the main season fish is used within four to five hours after receiving but during the slack season it becomes necessary to collect the fish over a period of 24 hours so that there is sufficient supply to operate the factory for about eight hours. The total storage capacity of one of the plants visited was 2,400 bushels.

Sardine is generally canned in 3½ oz. flat cans. At an average, 120 cans are packed per bushel (approximately 500 fish per bushel). Generally four to eight sardines are packed per can depending upon the size. The wastage is 40% to 50% as the fish is canned without heads. Viscera is not removed from the fish. The fish which shows even the slightest damage to the belly portion is rejected as this is considered to be a clear sign of deterioration. One of the canneries visited had the manufacturing capacity of 3,500 cases per eight-hour day.

Canning : Fish from the storage tank is elevated to the second floor where it is washed and cleaned. After that it is delivered on the conveyor belts on both sides of which women workers stand. The fish is picked up and trimmed to the size of 3½ oz. square can. Head is cut off by means of scissors. Tails are also cut off only if the number of fish to be packed per can is less than eight. The filled cans are placed on trays which are then put on trolleys. The trays are locked on the trolleys so that the cans do not fall off during subsequent operations.

The trolleys are dipped into a tank to fill the cans with 15% to 20% brine. The strength of the brine and the period of brining depend upon the size of the fish. The brine is then drained off.

The trolleys full of fish cans are placed in a stainless (3-1-6 grade) steel tank with 20% brine and cooked for 6 to 14 minutes at 208°F. The foam from the cooking tank is removed by blowers to one side and from there it is sucked up under a hood. Then the cans are drained again for half to one hour until the water left in the cans is not more than 5 ml.

During the warm season, fish is allowed to cool in a tunnel with circulation of air for 20 minutes to prevent softening because of the high temperature attained during cooking. The trolleys are then removed from the tunnel and the trays are emptied on a conveyor belt. It was interesting to note the device used for emptying the trays. Each tray was placed on a table which had wooden blocks to push out the cans. The cans were then pushed on to a conveyor belt and the tray removed. Depending upon the type of pack desired the cans were then filled with 20 to 25 ml. of refined oil, tomato sauce or mustard sauce and sealed on a machine at a speed of 125 cans per minute. The rated capacity of the seamer supplied by the American Can Company is 150 cans a minute. This machine is given to the canners on a royalty basis by the manufacturers. The rate charged for its use is $ 22.00 per seaming hour. Some of these machines have also been sold for around $ 40,000 each.

The cans are then dropped into retorts partially filled with water to prevent denting. After a retort is filled, the water is drained off from below and the cans are processed at 225°F under steam pressure for an hour and then cooled. The retorts have an inclined plate at the bottom and an unloading gate from below, which adds considerably to the efficiency as the cans slide off, as soon as the gate is opened, directly on a conveyor, which takes them to a labelling machine and the packing room. Some canners wash the cans with soap and water during the cooling operation to remove grease from the surface and then label them. Semi-automatic labelling machines are used. For some fancy packs the cans are wrapped in tissue paper. Then 120 cans are manually filled into a cardboard carton.

Throughout the preparation and processing operations samples are drawn by the State Inspector who continuously checks the quality at different stages. Official samples are drawn from the finished pack and sent to the State Laboratory for grading. This is done with the utmost efficiency so that there is the least possible delay. The certificate is usully obtained in 24 to 48 hours and the goods are then ready for despatch.

Three other plants visited followed slightly different techniques for processing of sardines, the main difference being in the technique of brining them and in pre-cooking. One of the plants was using a continuous tunnel for pre-cooking sardines after they had been filled into the cans. Another one was processing the canned fish at 232°F for 70 minutes and had a retort loading capacity of 14,000 cans. The third plant had facilities for washing the cans with soap after processing them.

Most of the sardine canneries do not have highly qualified technologists but have supervisors with long experience in the field and training provided by the State Sardine Research Laboratory. The supervisors also attend a number of short courses organised during the off season at the University of Maine and Massachussettes Institute of Technology.

The sanitary conditions in most of the plants are quite satisfactory. Systematic cleaning schedules are fixed for different parts of the plants.

Most of the fish processing units work on two floors. The ground floor is mainly used for receiving and storage of the fish as well as for labelling and storage of finished goods. Preparation and processing is mainly done on the first floor. Some of the canneries also use basement for packing and additional storage.

There is no observation period before despatch of the goods. Usually the finished goods are held for a maximum period of six months before sale and distribution.

Labour is paid on piece-work basis and the wages vary between $ 0.70 to $ 1.20 per hour depending upon the efficiency of the worker. The women workers can usually make up to $ 2.00 per hour. The cost of

production per case of 120 cans varies between $ 0.70 and $ 1.20.

Canning of Tuna : Tuna forms one of the most popular fish packs in the USA. The annual pack of tuna is around 10,000,000 cases, a major portion of which is packed in California.

White meat tuna pack gets higher price than dark meat pack. In a number of areas the tuna is canned all round the year because large quantity of frozen tuna is used. It was observed that frozen tuna is imported from Japan and some other South American countries. The species of tuna canned in the USA are Albacore, Yellowfin, Bluefin and Skip Jack. A large-size tuna weighs several hundred pounds but normally the weight of a tuna used for canning is between 10 and 30 lbs.

The prices of various species of tuna are as follows :—

Yellowfin	—	$ 300.00 per ton
Bluefin	—	$ 280.00 " "
Skip jack	—	$ 270.00 " "
Albacore	—	$ 340.00 " "

Tuna is caught by large boats some of which hold 800 tons and are like steamers. They cost as much as $ 2,000,000. The small tuna-cum-shrimp boats, which are 50 feet long and use 100 H.P. diesel engine, cost approximately $ 20,000. Most of the boats are owned by fishermen who are financed by the canners. Every year contracts are signed between the canners and the fishermen for supply of fish. Generally, the fishermen undertake to supply one company year after year.

As soon as the fish is received, it is washed and butchered or eviscerated. Then it is cleaned and placed in large racks or trays with silicone coated papers to prevent sticking. The trays are then placed on trolleys which are pushed into large steel cookers. The fish is then steam cooked at 216°F. The cooking time varies according to the size of the fish. Generally, 10 to 15 lbs. fish is cooked for three hours and 50 to 60 lbs. fish for five hours.

The oil which comes out during the cooking is collected as a by-product. The fish is then cooled overnight and delivered to the preparation table over a stainless steel conveyor belt. Skilled workers remove the bones by splitting the fish longitudinally and separate red and white meats. Chunks of white meat are packed as choice grade; the smaller pieces are packed as standard grade; and shreds are packed as grated tuna. The red meat is used for preparation of pet foods.

The cans are hand filled very carefully, then about 1/16 oz. of salt and about 1½ oz. of refined oil are added. Ninety per cent of the tuna pack is in 7 oz. cans. The other size of containers used for packing have 3½, 5½ and 11½ oz. filled-in-weight of the fish.

The cans are vacuum sealed with steam jets at a speed of 700 a minute, washed with hot water containing detergents, rinsed with fresh water and processed. The processing time for 9½ oz. cans is 110 minutes at 242°F according to the California State Law. The cans are then cooled under pressure to 100°F.

There is a continuous voluntary State inspection for quality control on the production lines at all levels. Samples of the finished product are finally graded and then a decision is taken on the label to be used. The services of State Inspectors are paid for on a per case basis.

The plant visited by the Team had a very strict sanitary control of its own in addition to the State supervision.

The total manufacturing capacity of the plant for canned fish is 200 tons a day (45 cases of 48 cans make one ton). The plant operates five days a week throughout the year.

Costing Information relating to packing of Tuna

Price of carton used for packing 48×7 oz. cans is about 8 to 12 cents each, depending upon the strength desired.

The cost of 48 seven oz. labels is 8 cents.

50% of the cost of the pack is fish itself, 10 to 15% is labour and the rest is divided between marketing, overhead, warehousing, containers, carton and labels.

Containers cost 3 cents each, carton 10 cents each and labels 8 cents.

The movement of the goods from the warehouse to the consumer through the normal supply line takes a maximum of three months. The price of canned fish (48×7 oz. can) to the wholesaler is as follows :

White meat—$ 14.00 to $ 15.00 per case.

Chunks—$ 12.50 per case.

The factory reports that it turns its capital 17 times a year and is trying to increase it to 19 times.

Fish Meal : Fish meal is prepared from the waste and sold as poultry feed. Some of the waste is also used for the manufacture of amino acids.

All the scrap and the waste is passed through a hydraulic press where oil and water are extracted. The scrap is steamed during pressing. The material is passed through a grinding mill simultaneously with squeezing. Then it is dried in a rotary drum drier which is directly heated by gas at 215°F and packed in 100 lb. bags. The production capacity of the fish meal plant is 600 lbs. per hour.

This particular fish processing organisation had a very well developed research, quality control and product development laboratory. As a result of the work done by the laboratory it had been possible to manufacture a large number of by-products specially amino acids which brought large profits.

Manufacture of Amino Acids : A major portion of the process is kept secret. After hydrolyzation by chemical treatment, the material containing 20 to 45% solids is homogenised and then spray dried in a 45 feet long drier. Mixed amino acids are generally prepared. These are packed in cardboard cartons with plastic lining. The final product is almost smell-less.

Manufacture of Clam Chowder

1. Deep sea clams are received and kept in cold storage.

2. They are cleaned and cut into small pieces in a special grinder.

3. They are washed in their own juice. The whole material is allowed to decant for settling down of the sand particles.

4. 300 lbs. of potatoes are peeled under 90 lbs. steam pressure in 2½ minutes and then the skin is removed by water jets. The peeled potatoes are then cut into cubes.

5. Potato cubes, clam pieces, sauce, shreded onions (dried), some corn starch, clam juice and a small amount of monosodium glutamate are mixed together and cooked.

6. Chowder thus prepared is filled in two sizes of cans—(1) 300×407 or 15 oz. cans & (2) 404×600 or 46 oz. cans. The cans are vacuum sealed using steam jet device on the seamer. Only C enamel cans are used.

7. The small cans are processed for 70 minutes and large ones for 2½ hours at 242°F in stationary retorts.

The chowder manufacturing capacity of the plant is 3000 cases per day. In addition to clam chowder, fish chowder, clam Ala King and Welch Rabbit are also manufactured.

The plant has a very good quality control check. The finished product is finally examined for the following :

1. Vacuum minimum 7"; 2. Fill of the container; 3. Headspace maximum 3/16"; 4. Can condition; 5. Flavour; 6. Colour; 7. General appearance; 8. Number of clams pieces; 9. Number of pieces of potatoes; and 10. Bacteriological analysis.

Continuous cooker is not used for processing as it curdles the chowder.

The plant has an excellent workshop and makes its own equipment.

M. Meat Processing In Denmark

Meat processing is one of the largest industries in Denmark. The main factors

esponsible for its success are the availability of very high quality raw material, traditionally developed techniques of processing combined with modern technology and very efficient marketing. The foundation of this industry like any other food processing industry is the raw material. Denmark has a big lead over other countries in this direction.

Denmark produces 10,000,000 pigs of the Danish Landrace annually. These animals are fed in a very scientific manner. Their diet consists mainly of barley and skimmed milk fortified with minerals and vitamins. Sometimes small amount of antibiotics are mixed with the diet to speed up their rate of growth. It is very necessary to maintain a close check on the health of these animals so that they are free from diseases which may interfere with their healthy development.

The pigs are sent to the slaughter houses when they are about six to eight months old and their weight is between 130 and 140 lbs. This meat is used for the fresh market. Meat of animals weighing 160 to 180 lbs. is used for processing. The slaughter house pays the farmer on the basis of the weight of prepared meat. Usually 5 lbs. per animal is the blood which goes in the manufacture of by-products, specially animal feed. The average price paid for the first grade of meat is 4 to 4.5 Kroners per lb., and for 'B' grade meat it is 3 to 3.25 Kroners. Pitutory glands are used for the manufacture of insulin.

About 75 per cent of the meat produced in Denmark is exported fresh. Only 10% is used for the manufacture of various processed products. The rest is consumed fresh in the country.

Denmark has 120 slaughter houses which are very well planned and efficiently run. They have introduced continuous line operation throughout the slaughter house and, therefore, the efficiency has increased tremendously. At an average, the slaughter house prepares about four animals per man hour.

Slaughtering : Pigs are received in slaughter houses on trucks and then put into pens, from where they are driven on to a conveyor which take them to a carbon dioxide chamber for gasing. As they come out of the chamber, they are hung up on hooks on a moving conveyor chain and then are slaughtered by sticking a sharp double edged knife through their gullet and cutting the main artery leading to the heart. It takes about five to six minutes for the pig to bleed completely. The same conveyor chain carries the animals to the scalding tanks where they are put into boiling water for six minutes. After that they are hung up again on the same conveyor chain. Hair are removed by scraping with sharp knives. Then they are singered for any remaining hair, cleaned with revolving brushes and stamped by the use of gas heated stamps. As the carcasses travel on the chain they are cleaned part by part until the viscera comes out and is sent down on another conveyor. Electric saw is used for cutting bones at different stages until the animal is divided into two sides. A special jaw puller is used to remove the jaw from the head. After that it is weighed and sent to the cold storage maintained at 34°F. Four sides weighing approximately 250 lbs. are packed in a jute bag and exported. The slaughter house visited by the Team had a curing plant in the UK which did rest of the processing before marketing the meat.

Many slaughter houses cut off the sides of animals into ham, bacon and shoulders which they sell to the processing factories. Heart and liver are packed separately. Lungs are used for manufacture of inedible products and poultry feed. Bone meal is made from the bones. Fat is rendered into edible lard.

The meat and viscera are regularly examined by veterinarians at different stages on the lines. Rejected carcasses are destroyed in incinerators to prevent any possible use, even for manufacture of by-products. This also prevents the possibility of spreading any disease.

Processing of Meat : Hams, bacons and shoulders are transported on hooks to the processing plants. On arrival at the plant they are placed in cold storage. The steps involved in the manufacture of canned meat products are as follows :

1. Meat is supplied to butchers on the trimming tables. Here it is trimmed and made ready for pickling or curing.

2. Pickling brine, containing 18% salt and 0.5 % sodium nitrate, is pumped into meat by using a semi-automatic or fully automatic brine injectors. The quantity of brine pumped is 10% of the weight of the meat.

3. After this the meat is kept for about a week in stainless steel tanks containing the brine of the same composition as used for injection into the meat.

4. After the brining period is over, the meat is removed from the tank, drained and smoked. The smoke house in one of the plants was very efficient. It had two levels. On the first level, sausages were smoked and the same smoke was allowed to travel to the second level where ham and bacon were smoked. Thus there was a saving of fuel and space and the temperature control was easier. Generally, birch wood is used for smoking.

5. After smoking meat is trimmed and the bones are removed.

6. Then it is manually filled into different sizes of containers and gelatin is added in order to prevent scorching of meat during processing and to fill up the sides of containers to present a good appearance to the meat when the can is opened.

7. The cans are then processed in stationary retorts at the following temperature :

(a) 1 lb. and 2 lbs. containers at 120°C for 1½ hours.

(b) 3 lbs. containers at 120°C for 3 hours.

(c) 9 lbs. containers at 70°C for four hours and then kept in cold storage.

Trimmings and fat are used for the manufacture of luncheon meat and sausages. For the manufacture of lunch meat, beef is also mixed. The material is ground and salt and spices are mixed. After that it is filled automatically into different sizes of cans which are vacuum sealed. The processing times for luncheon meat is as follows :

(a) 6 oz. cans at 180°C for 50 minutes.

(b) 2 lbs. cans at 180°C for 2 hours.

Sausages are prepared by grinding the meat and fat together to make a smooth paste. Those meant for export to the USA contain 20% fat while those meant for consumption in Denmark contain 40% fat. After preparing the mixture, salt and spices are added and then the paste is automatically filled into artificial casing which is mechanically tied at regular intervals to give the sausages the correct shape. Then the chain of sausages is placed on wooden rods and hung in the smoke houses. After smoking the casing is mechanically removed and the sausages are packed in polyethylene bags and kept in cold storage for fresh market. Also fairly large quantities of sausages are packed in tall printed cans and processed at 180°C for a period varying between 50 minutes to two hours depending upon the size of the containers.

The equipment used for grinding, mixing and filling the meat is automatic. Conveyor belts used for handling meat are made of stainless steel or nylon. Floors are made from special fat resistant cement compositions and have an average life of 25 years.

After the various meat products are packed in cans the keys are soldered on to them which are used for opening the containers. Then they are filled in cardboard cartons and arranged on pallets. The pallets are carried by fork-lift trucks to the stores. The factories do not keep stock of meat products for more than two weeks. One of the factories visited by the Team was manufacturing 150 tons of meat products per week.

N. Packing of Poultry

The poultry packing plant visited by the Team in the USA was very modern and automatic. In fact it was the most efficient food processing unit seen during the tour. The plant packs 70,000 chickens a day. The chickens are brought to the plant when they are eight weeks old and weigh 2¼ to 2½ lbs. each. These chickens were grown on 200 farms under strict supervision of the pathologists, geneticists and technologists of

the processing plant. At an average 4 to 5 lbs. of feed is given to the chicken over a period of eight weeks. Thus the conversion ratio of feed to chicken was 2 : 1. Only white rock breed is used.

The birds are inspected daily at the farm before they are despatched to the plant. Female birds are preferred as they pick up weight better than the male bird. The plant sells the prepared chickens to the New York market at 31 cents a lb. delivered.

The steps involved in preparation of the bird for marketing are as follows :

1. The birds are hung on a specially designed conveyor by sticking their legs into a stainless steel frame and carried into a chamber.
2. The neck is slit and the birds are allowed to bleed.
3. They are then scalded in water at 175°F for two minutes with constant agitation.
4. The remaining feathers on the bird are removed by roller brushes and rubber fingers. The feathers are floated back for collection and sold to the manufacturers of by-products.
5. The birds are singered by gas burners.
6. Then they are inspected.
7. They are washed.
8. A cut is made and the viscera is removed.
9. Feet are cut and tail is removed.
10. Government veterinary inspectors check the birds systematically for any disease.
11. Quality grading is done by specially trained personnel.
12. Giblets (liver, gizzard, heart) are removed from each chicken and packed separately in wax paper. Offal goes for the manufacture of poultry feed.
13. Head is separated by pulling.
14. Lungs are removed by powerful suction.
15. Chickens are washed again and chilled in a tank at 40°F.
16. Giblets which have been packed in paper are put back into the chicken.
17. The birds are automatically size-graded according to the weight and then packed in plywood cases with plenty of chipped ice.

The poultry thus packed does not stay in the plant for more than a day.

Throughout the entire preparation work, the same conveyor chain carries the birds right from the time they are received till they are packaged. The operation takes two hours. The total length of the conveyor chain is five miles and all the parts which come in contact with chickens are made of stainless steel. The packed birds are transported in refrigerated trucks with ice to the markets, the main one being New York City, which is 380 miles away. It takes about ten hours to transport the goods to New York.

Throughout the preparation line, there is a careful inspection for quality control.

Bruised birds are separated and utilised for the manufacture of cut chicken and pre-cooked frozen products such as chicken rolls, mixed meat, etc.

P.V.C. stretch film DISTAN is used for packing pre-cooked chicken products. The price of 1,000 bags of 5″×13″ is $ 25.00. In case of spiced chicken, sauce is pumped into the bags before sealing them. The chicken in the bag is then cooked at 175° to 180°F for two hours. The machine used for sealing the bags is manufactured by M/s. Tipper Tie, Union, New Jersey.

O. Packing and Processing of Eggs

The Team visited two egg packing plants. One of these is located on the east coast of the USA and the other on the west coast.

Both the plant operators reported that the small egg producers are disappearing as it had become almost imperative to have a large number of chickens to produce eggs economically.

Formerly there were small farms with 1,000 chickens but most of the present farms have 10,000 chickens in the east and 30,000 in the west. Some of the large farms have up to 200,000 chickens. One of the plants collected eggs from 3,000 farms while the other from 10,000. The price of eggs varies in both areas, being a little cheaper along the west coast than in the east. Also the price fluctuates slightly from season to season. The farms grow their own pullets. The breeds of chickens used on these farms are the White Leg Horn or Rhode Island Red. It is normally estimated that 4 lbs. of feed are required to produce one dozen eggs. The price of feed is $ 4.00 per bag of 100 lbs.

It is estimated that the expenditure involved in building a 10,000 chicken farm is approximately $ 3.00 per bird. This covers the cost of chicken house, nest, laying house, automatic equipment such as, conveyors, etc. but exclusive of the bird. After 12 months of laying, the bird is sold as a fowl. Usually the quality of eggs goes down after 10 months of laying. The advantage of Rhode Island Red is that it is a heavy bird and brings good price to the farmer when he sells it as a fowl.

The cost of packaging eggs is about 7 cents per dozen. This includes the cost of collection, grading, packing in one dozen and 2½ dozen cartons, casing, transportation, labour and delivery to the market plus a margin to cover the overhead, depreciation and some profit.

Most of the operations in the plant are carried out automatically. The following outline gives an idea of the various stages of collection, packaging and distribution:

1. The eggs are collected by the packing plant's own trucks from its various suppliers within a radius of about 100 miles.

2. If the truck starts out on collection in the morning, by 3 p.m. it usually has a full load of 800 cases of 30 dozens. Then it proceeds to the packing plant. The eggs collected on one day are graded the next day. The 30 dozen egg cases are opened and each layer of 30 eggs is picked up by a vacuum lifting device and placed on a special conveyor belt which takes it into the candling chambers. Here the eggs are graded for quality factors such as, freshness, shell defects, cracks, etc. One of the plants used semi-automatic device for this purpose while the other used completely automatic electronic device. The eggs having defective colour, dirt and soil or thin shell are rejected.

The good eggs are then automatically graded for size and sent on different conveyor belts for inspection by workers who place them into one dozen or 2½ dozen cartons. Different colour cartons meant for different grade of eggs are automatically opened and supplied for filling on another conveyor. The filled cartons are conveyed to the store room where they are packed into cases of 30 dozens and stored.

The store rooms are maintained at a temperature of 50°F. At this temperature the eggs have a shelf life of 30 days. It is not advisable to keep the eggs at lower temperature because they begin to sweat and the moisture collection on the surface leads to various types of spoilages.

The eggs are delivered in Company's own trucks to the market areas in a radius of 135 miles. Some of the small stores take one to two cases a week while the super markets take 200 cases a week. One of the plants made deliveries only thrice a week. If the eggs remain unsold in the market for four days they are collected and taken to the plant. These are usually sold again.

The Company reported that 97% of the eggs received from the farm are placed in grade 'A' while some are sold as 'AA'. This shows the quality consciousness of the egg producer. Small quantities of eggs with defective shells or cracks are sold at the factory for 10 cents less than the market price. The market prices for different grades of eggs are as follows :

1.	Jumbo 30 oz. per dozen	$ 0.49	Rs. 2.32
2.	Large 27 oz. per dozen	0.44 „	2.09
3.	Medium 20 oz. „ „	0.32 „	1.52
4.	Small „ „	0.15 „	0.71

The average price paid for undergrade eggs is 20 cents.

The prices are determined by the market reports and depend upon supply and demand. They are changed three or four times a week but the variation is only a few cents. A plant on the west coast supplies such a large portion of the egg requirement in its area that whatever price it fixes, becomes the market price.

One of the plants visited had an investment of $ 250,000 in building and equipment.

The plant on the west coast also freezes and dries eggs.

Freezing of Eggs

The following steps are involved in preparation of frozen eggs.

1. The eggs are taken out from the cases.
2. They are washed.
3. They are broken.
4. The yolk and the white are separated.
5. The white is whipped and mixed with yolk again.
6. 30 lbs. cans are filled and frozen at—25°F.

Semi-automatic machinery is used for the entire operation.

The following types of products are frozen as they have good demand for various purposes :

1. Yolk alone
2. Yolk plus 10% sugar
3. Yolk plus 10% sugar plus salt
4. Egg white
5. Egg white plus salt
6. Whole eggs

These products are mainly sold to the bakery trade. Mostly undergrade and poor quality eggs are used for this purpose.

Drying of Eggs

Up to the time of mixing the white with the yolk, the preparation for drying is the same as in the case of freezing. The mixture is pumped to a 50,000 lbs. tank then it is pasteurised and cooled. After that it is spray dried and packaged in 150 lb. polyethylene-lined cardboard drums with metal ends. The final moisture content of the dry eggs is 2%. This product is purchased by the US Government as a price support measure.

P. DAIRY INDUSTRY

The Team visited only a few dairy plants, one in Denmark and three in the United States. A common feature was the high productivity of cows in both the countries. It was significant to note that while the population of cows was going down, the milk production was maintained or increased. The availability of milk was considerably larger than the demand for milk and milk products. Unlike the conditions in India, the problem faced by the industry is how to create demand for various dairy products. Greater emphasis is now being laid on the protein of the milk than on the fat which has been the basis of dairy economy so far all over the world. This factor has affected the production of various units and of course the marketing. Surplus butter in Denmark is exported by subsidising it to a very large extent. This is done by the industry. In the United States the Government subsidises the industry through the price support programme which takes care of surplus of the dairy products. The Team was informed by one of the leaders of the dairy industry that eventually the price of butter fat would have to come down to the level of vegetable fat. The milk industry must, therefore, look for new composition of price to maintain the balance of its economy by due emphasis on the higher nutritional value and price for milk protein. In Denmark, there is already a movement to recognise this factor. In the United States, California has recently started paying on the basis of fat and solids-not-fat (protein, etc.) in milk.

The formula used in California to pay for milk on the basis of fat and solids-not-fat may be of some interest in India since we have a problem of adjustment between the prices of cow's and buffalo's milk. Perhaps a similar formula can be worked out to enhance the price of cow's milk. The formula is worked on the following basis :

(a) The fat in milk is paid @ $ 0.99 per lb. of fat (i. e. Rs. 4.70).

(b) Every 100 lbs. of milk is paid @ $ 1.93 (Rs. 9.16) as a value of solids-not-fat as additional price.

The above price works out at Rs. 25.21 per 100 lbs. of milk of 3.5 per cent fat.

Milk is classified as 'A' class when it is sold for liquid milk but when the same milk is used for manufacture of products the price paid is 20 to 25% lower. In California, the price at which milk is purchased or sold is controlled by the State. The State Inspector certifies the quantity of milk used by a dairy according to the usage. The producers, therefore, insist that a larger quantity of milk is sold as liquid milk.

Many persons contacted in the field of dairy industry stated that one of the major problems is to keep a watch on the losses of fat and solids-not-fat in the operation of the creamery. On going into the details of the question it was found that a fat loss of 1 to 1.2% is not considered abnormal. The quantity account of solids-not-fat is generally not kept. However, the new interest in protein is likely to make the industry more conscious of this factor. Dairies maintain the day to day account of milk and its fat content and show the management the figures of the invisible losses. Steps are taken to remedy the losses in every department. At most of the places, physical stock of the items of production is taken once a day to give an idea of quantity account.

The large units of our dairy industry are quite comparable with the industry in Denmark and the USA, except in the case of the collection of raw material. As the dairy farmers own large herds of cattle the production per farm is quite large and the method of the collection is different. The use of chilling tanks and bulk handling of milk is wide spread. This, of course, improves quality of milk considerably. The testing of milk is done by U.S.D.A. certified testers who operate the trucks. This is a great convenience.

The observations of the dairy industry which may be of some use to the industry in India are :

1. Cattle feed of varied nature is used. Pineapple waste, citrus waste, fish meal and other agricultural waste are used extensively. In India there is a good possibility of introducing fish meal, as well as cattle feed based on agricultural waste. This would result in a tremendous advantage in the cost of milk production.

2. Developments of products like cultured butter milk and cultured cream are of interest to us. The processes used for their manufacture are simple and can be introduced in India. For instance, in case of sour cream the product is filled in cartons and inoculated with the culture and kept at 70°F for ripening. As soon as the desired acidity has developed the cartons are removed to the cold storage. The butter milk is made from pasteurised milk with 2% fat, cooled to 70°F. The bulk is then inoculated with starter. When the butter milk develops acidity of 0.82% the bulk is stirred, cooled to 40°F and filled into cartons. The product has an excellent body and flavour and is becoming popular.

3. Like our doubled toned milk, a product with a composition of 2% fat and 10% solids-not-fat has been introduced as low calorie milk. Higher percentage of S.N.F. gives the product the desired body and flavour which generally come from higher fat content.

4. Most of the liquid milk is packed in cartons. Some of the dairies still use ready-made waxed cartons but of late the use of "pure pack," which is a polythene laminated flat carton has become quite common. The price of a single service 4 lbs. capacity carton is 3 cents while that of glass bottle is 27 cents which gives about 30 deliveries. The bottles have to be brought back and washed and require careful handling. The high speed line for pure pack is convenient but costly to instal. The use of large-size plastic bags with a capacity of 4 to 5 gallons of milk for bulk deliveries are of interest. The plastic bag is put into a dispensing cabinet and milk is drawn through a tube connected to the spout of the cabinet. It may be possible for us to introduce such a system for dispensing milk in some of our schemes without fear of adulteration and cut the cost of distribution as compared to bottled milk.

5. A large number of dairies utilize their filling capacity to pack fruit beverages in

cartons or in bottles. This increases their plant utilisation and reduces overheads. It may be possible to introduce packing of fruit beverages in our dairies as it would not only utilise the plant capacity but also make the delivery economical.

6. Certain new products have been developed like yoghurt with orange and lime juice. Use of fruit juices in milk products is becoming popular in Europe. It may be possible to introduce similar products in India based on banana, mango and other, indigenous fruits. Of course, the problem is the availability of milk but by such blending we may be able to make our limited milk resources go farther.

7. Milk powder is mostly produced by spray drying. It was observed that hot air is drawn into the drying chamber directly from the heaters using either natural gas or oil. This obviously reduces the cost of operation considerably. The powder does not have off flavour inspite of drawing the direct fire-heated into the chamber. At one of the factories it was observed that milk powder was packed in bulk containers and stored for a few days prior to filling in consumer size containers. It was stated this is necessary to get rid of the static electricity, which the powder had acquired and, therefore, it is not possible to fill it conveniently to the desired volume.

8. Cottage cheese is gaining importance and, therefore, many dairies are switching on to mass production of this item. However, there are problems with regard to the marketing and distribution of cottage cheese which is a highly pesirhable commodity.

5 : Containers

THE STUDY OF THE CONTAINER PROBLEM is important for the productivity in the Food Processing Industry but the subject has been covered in a comprehensive manner in the report of the Team on packaging which visited the United States, Switzerland and Japan in 1960. Therefore, this chapter covers briefly only those aspects which directly relate to the productivity problems studied by the Team.

The tin container continues to be the most widely used one and, therefore, it will be discussed in greater detail than others. The glass containers come next in the order of their importance and are preferred for packing a number of products. Plastic containers are becoming quite popular because of their ease of handling and attractive appearance although there are certain special problems involved in using them. The Team also observed the use of single service plastic and aluminium foil containers for packing a certain number of products like jam and butter. Cardboard containers are also used for packing jams in Denmark.

Glass Containers

Glass containers are preferred for packing jams and tomato ketchup in a number of countries. Wherever these containers are used the conventional screw-caps are being fast replaced by the new twist-off caps which can be fixed on the container at a faster speed by means of the machines and provide a more elegant appearance to the pack. These caps have also reduced the chances of leakage and are easy to open.

The price of tomato ketchup bottles of 450 gms. capacity in Denmark is 0.29 kroner (Re 1=1. 451 kroners). This price is approximately half of what a similar bottle would cost in India. The use of twist-off caps has increased the efficiency of bottling. As against this, it is necessary for the Indian Food processors to make use of crown corks plus an over cap. The filling and sealing speed reported for tomato ketchup in one of the plants visited in the United States was approximately 400 bottles per minute.

In Denmark it was observed that jam jars of one pound and 12 ounce capacity are quite popular. The price of one lb. Jar is about 0.52 kroner and that of 12 ounce jar is 0.48 kroner, without the cap. The price of twist-off cap is approximately 0.18 kroner. Most of the glass bottles are packed in cardboard cartons which have a bursting strength of 300 lbs. per square inch. It was reported that the breakage was less than 0.02%. This is primarily because of the careful handling. India has much to learn in this direction.

Plastic Containers

It was observed that flexible plastic containers made from high density polyethylene are becoming quite popular. The price of a 300 gram tomato ketchup container with cap is 0.29 kroner in Denmark. Thus the price is almost the same or perhaps a little less than the glass containers. These containers are also popular for packing mustard and other pasty products. The tomato ketchup containers are re-usable as the manufacturers supply 300 gram refills in plain high density polyethylene film. This has added attraction for the consumer. Another advantage of these containers is that they have reduced the weight of the pack and have eliminated breakage completely. The major difficulty, however, is the short shelf-life. It was re-

ported that the products packed in these plastic containers do not retain proper flavour for a period of over three to four months. Therefore, their use is confined to products meant for local or nearby markets.

One more advantage of these containers is that besides being attractive they can be printed and, therefore, the labelling problem is completely eliminated which adds to the efficiency of the operation of production line.

Single Service Containers

Two kinds of single service containers were observed, those made from flexible or rigid plastic and those made from aluminium foil. In case of the latter, the foil is fed into the machine which forms it into the desired shape, fills it with the product and then seals it. These packs are more expensive as compared to larger ones but they are more popular in countries where labour charges are high, and, therefore, there is preference for their use in hotels, restaurants and by Airlines. The housewife also prefers them because it is possible for her to obtain a wide variety of jams for use on the table. These containers are sold in cartons of one dozen and two dozen each.

Cardboard Containers

In Denmark the use of printed waxed round cardboard containers is quite common for packing jams. These containers have the advantages of attractive (printed) appearance, light weight and no breakage. The only operational problem presented by these containers is that it is necessary to leave them covered with polyethylene sheets and allow the contents to cool before the lids can be fixed. Also the filling temperature of jams has to be considerably lower than in case of glass containers. As these containers cannot be vacuum-sealed it has become necessary to use sodium benzoate as a preservative in jams which is legally permitted. It may be worth introducing such containers in India depending upon the availability of suitable raw material for their manufacture as that would result in saving of tinplate.

Tin Containers

The tin cans continue to be by far the most popular containers for food packing and, therefore, much advance has been made for increasing the productivity in their manufacture. Both in Denmark and the United States, the automatic manufacture of open top cans takes place at a high speed of the order of 400-600 bodies and 600 or more ends per minute. The economy of the body-maker is also assisted by long runs of a single size. In the can making plant visited by the Team in Denmark only 3 of the 14 body-makers had provision for making cans of different diameters, the rest being able to manufacture only one size.

In the United States of America, some of the large canners have started manufacturing their own containers. One of the canners stated that their can manufacturing department had declared the largest profit. The canners usually manufacture only the sizes of containers used by them in large quantities while they purchase those required in smaller quantities from the can manufacturers.

Over the last few years, there has been a systematic effort made in the United States with the help of the National Canner's Association to standardize the sizes of cans used for packing food products. It is stated that 4/5th of the annual pack of canned fruits, vegetables and juices is in the following nine sizes :

Capacity	*Name*	*Dimensions*
8 ozs.	Buffet	211 × 304
10½ ozs.	Picnic	211 × 400
12 ozs.	VAC No.2	307 × 306
14-16 ozs.	300 cans	300 × 407
16-17 ozs.	303 cans	303 × 406
1 lb. 4 ozs.	No. 2	307 × 409
1 lb. 13 ozs.	No. 2½	401 × 411
1 qt. 14 fl. ozs.	46 ozs. No, 3	404 × 700
6½-6¾ lb.	No. 10	603 × 700

Even though the number of sizes of cans has been reduced, the demand is diverse enough to require tinplate of four different specifications, 10 different gauges, 7 different temper rollings and 9 different tin coating thicknesses. One leading can maker in

the United States works with 15 basic enamels for the internal lacquering of different types of cans. The leading can manufacturers in the United States take "primes with seconds arising" tinplate for supplies of containers to processed food manufacturers. In Denmark the leading manufacturer uses 'primes only' as well as 'primes with seconds arising' which are sorted before use, if necessary.

Research on tinplate has made significant contribution towards keeping down the price of cans. Today most cans are of thinner gauge than they were before the last war (e. g. 300 and 303 cans-70-80 lbs. tinplate, No. 2½ cans-95 lbs. tinplate). To strengthen the cans made from thinner tinplate, continuous or interrupted beading of the body is done on cans from diameters 300 up. Double reduced plate, with a substance of 60 lb. per basic box, is used for beer cans and to a certain extent for fruit juices. The use of lower tin coatings, originating from the scarcity of tin during the war, has also helped to reduce the cost of cans. *Very few commodities are now being packed in cans made entirely from hot dipped plate.* The following types of cans are in common use :—

Electrolytic 0.50 lb. — internally lacquered.

0.25 lb. — -do-

Electrolytic (differential) 0.75 lb. inside plain, 0.25 lb. outside, ends 0.25 plate inside lacquered.

1.00 lb. -do-

Electrolytic tinplate with 0.75 lb. per basic box coating is considered to be almost as good as the hot dip plate with 1.25 lbs. per basic box coating for packing most of the products. The results of research have proved this. The further reduction of the substance of the tin coating have given rise to some problems. Cans made from lighter gauge plate, particularly the double reduced plate, are naturally more prone to damage in rough handling. Yet because of the economy in price, the use of containers made from thinner plates is very common. Reduction of tin coating to very low levels, such as, 0.25 lb. outside has reduced corrosion resistance.

Two types of internal lacquers are in general use the sulphur resistant or C-enamel, and the acid resistant or the fruit-enamel. A number of lacquers of each type, suitable for different products are available. For exceptional packs a combination of the two types may be used.

Wherever possible, the plain container is preferred for fruit and vegetable packing as the reducing property of tin helps in better retention of certain vitamins and prevents darkening of the product. However, for coloured fruits and more corrosive packs, internally lacquered tins are used with side striping on the side seam. In Denmark a number of irregular cans were seen for packing meat. Many of the larger sizes had lap-soldered side seams. Solid packs meat for cold storage are often first wrapped in a ploythene bag which acts as a liner between the meat and the can. A considerable amount of research work is in progress on the use of polypropylene liners.

Meat is packed both in plain and lacquered containers apparently depending on the canner's choice. The consumers are not particular about the stains inside the cans and in plain cans sulphur staining is not objectionable in most cases unless the pack is also blackened. In Denmark peas are also packed in plain cans.

An interesting example of the same product being canned in both lacquered and plain cans is that of the orange juice. In California the orange juice is packed in lacquered cans whereas in Florida it is packed in plain cans. The pH of the latter is, however, slightly higher.

It is also common to find cans where the body is plain and the ends lacquered on the inside. In most cases, this is merely to allow for the use of 0.25 tincoated plate for the ends. Where the product is in the acid range e.g. tomato juice, use of this kind of container leads to a fair amount of detinning of the body but this is not found objectionable. In fact the consumers being oriented to the flavour which develops in contact with the tinplate of the plain can, it is now accepted that the flavour of tomato juice "improves" in storage. Sulphur resistant

lacquers are also used only for the ends for packing certain products. The added advantage here is that with sulphur bearing packs the end presents an unstained appearance when the can is opened. The staining of the body, which is plain, is not considered objectionable. American canned fruit market is perhaps the most conscious and discriminating one. There is much for the Indian industry and the Government to learn from this and not to set standards so high as to create difficulties which can be easily avoided. If the use of electrolytic tinplates with 0.75 coating per basic box could be accepted in India, it would provide more attractive cans at a reduced price and the reduction in shelf-life may not be significant enough to outweigh the price advantage. Such containers should be accepted by the Defence Services as the products imported by them are packed in containers made from this type of tinplate. Steps should also be undertaken to ascertain the suitability of thinner tinplate with less coating substance for further reduction of the can prices in India.

Most of the canneries in the USA and Denmark are located not too far from the can manufacturing plants. The containers are delivered to them in cubical cardboard cartons carrying a varying number of cans according to the size (e.g. 4096 of No. $2\frac{1}{2}$ cans). The cartons are stacked four or five high, apparently without any damage to the cans and are re-used. In larger canneries the Team saw mechanical (magnetic or vacuum operated) equipment for removing cans from the cartons and for placing them on conveyors which carried them to the production line.

It was of special interest to note that the stock of empty cans was held in the canneries at the cost of the can manufacturers who actually paid the rent for the warehouse used. Usually it is not necessary to hold very large stocks of cans as the container manufacturing plants are located nearby, but larger stocks are held during the off season. Considering the production capacity of the canners in the USA the can stocks held for two or three days are equal to several months requirements in India.

The can manufacturers render manyfold technical services to their customers. Apart from the research on cans, new products are developed and tested by them. The research organisation of the can manufacturers have made significant contribution to the development of containers, canning and the standardization of products. Their Technical Service sections have also helped the canners with technical problems of special nature. They have even helped the canners to design various types of conveyor systems for handling empty and filled containers.

In the United States of America, the price of containers varies slightly from one part of the country to another. The major factor which contributes to the variation is the distance from the steel plant to the can manufacturer. The prices of cans supplied by the can manufacturers to large and small canners are maintained uniform under the Federal Law. Thus it is not possible for the can manufacturers in America to give quantity, discount or price concession for purchase of larger quantities of cans by big canners. This has helped the small canners to stand up in competition. In Denmark the price lists are not published. It is, therefore, quite obvious that the prices are negotiated between the canners and the can manufacturers according to the sizes of orders placed.

As far as the price of empty containers is concerned, the Indian canner was on par with his counter-part abroad until the subsidy on the tinplate was withdrawn, although there have always been wide variations in the price of containers from one part of the country to another due to distances between various locations of the canneries and the can manufacturing units.

Table I on next page gives the price of cans delivered in different parts of India in comparison with the prices in USA and UK. It is quite obvious that the Indian canner is at a tremendous disadvantage today and needs speedy help not only to compete in the foreign market but also for development of the industry in the country.

The lithographed cans have found much favour in the United States and Denmark

TABLE I

Comparative Prices of A2½ Cans Delivered

Factory Price in Rs. per 1000

	INDIA					*USA**	*UK*	*Australia*
	Calcutta	*Delhi*	*Bombay*	*Madras*	*Cochin*			
Prices of built-up cans at various points allowing for can-maker's reduction and Govt. subsidy (31.3.63)	188.79	230.49	190.36	232.48	235.99	223.87 (1.5 hot dipped) 208.95 (Body 0.75 inside 0.25 outside Ends 0.25)	187.39	251.38
Prices of built up cans at various points allowing for can-maker's reduction, but without Govt. subsidy and including increased import and excise duties (1.5.63)	281.78	323.48	283.35	325.47	328.98			
Export can prices allowing for Export concession drawback on tinplate and concessional tinplate net price for Export on 31.3.1963	126 37	163.90	127.78	165.69	168.85			
on 1.5.1963	210.06	247.59	211.47	249.38	252.54			

* Prices are F.O.B can-makers' factory. Conversion used $ 1=Rs. 4.75

Note :

1. US prices are of 1960 from the Almanac of the Canning, Freezing, Preserving Industries.
2. In UK and USA the packing and freight elements that the canners incur are negligible because most of the can-making plants are situated close to the canneries. In India, on the other hand, the can-making plants are situated in two main cities whereas the canneries are spread all over the country. The cost of packing and freight that the canners incur contribute substantially to their cost, approximately 26% (31st March 1963) and 17% (1st May 1963) of the concessional Export prices. This is in spite of the flattened can system of supply where the costs of packing and freight are much smaller than for built-up cans.
3. The withdrawal of the Government subsidy and the imposition of additional customs and excise duties have made the export prices higher from 123.37 to 210.06 in Calcutta and similarly for other places; but it is understood that the Government intend to give further incentives to nullify the effect of the increases.

and the development of such containers in India would certainly help in increasing production efficiency by eliminating the use of labels at the same time making the product more attractive to the consumer. It was observed that the can manufacturers in Denmark are supplying printed cans to meet the orders at the level of 15,000 to 50,000 containers. The can manufacturers in India should offer similar facilities to the food packers.

The Government of India must take cognisance of the fact that economy in price of tin cans is possible where the container manufacturers are located in the Centres using them. Today the charges for packing and transport containers in India are exhorbitant. In future the Government should license the location of can manufacturing units in the Centres where the food processing industries are located.

In general, the substance and tincoating of the cans used in the USA are lower than those of the Indian cans and this has helped to reduce the cost. For instance the following are the 1960 prices per 1,000 of A2½ cans of different types.

Hot dipped	1.5	$47.13
Electrolytic	0.50 (inside enamelled)	$44.98
Electrolytic	0.25 (-do-)	$44.17
100 lbs. differential	0.25 (outside, ends .25)	$44.19
75 lbs. differential	.25 (outside, ends .25)	$43.99

Table II appearing on next page gives a comparison between the cost components of four commercial products manufactured in India and the USA. The analysis should be of interest to the industry.

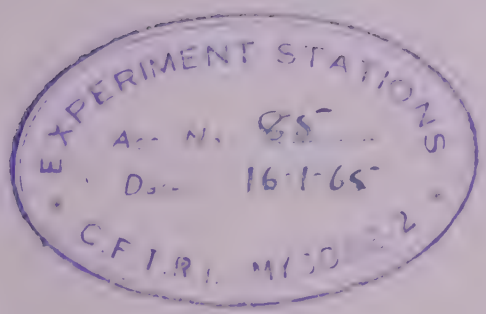


TABLE II

	INDIA					USA			
Product	*Size of can*	*Manufactured in*	*Wholesale price per doz.*	*Price of cans per 1000 as on 31.3.63*	*Cost of can as percentage of wholesale price*	*Price of can per 1000 as on 1.5.63*	*Size of can*	*Wholesale Price**	*Price of cans per 1000*	*Cost of the can as percentage of wholesale price*
			Rs.	*Rs.*		*Rs.*		*Dollars*	*Dollars*	
Peas	2½	Calcutta	16.00	188.79	14.2	281.78	303	1.15-2.05 average 1.60	30.80	23.10
		Bombay	20.50	190.36	11.1	283.35				
Tomatoes	2½	Calcutta	16.00	188.79	14.2	281.78	2½	2.15-2.55 average 2.35	43.99	22.4
		Bombay	23.00	190.36	9·8	283.35				
(Pineapple Segment)	2½	Calcutta	23.00	188.79	9.9	281.78	2½	4.025 (per case)	43.99	26.2
		Bombay	26.00	190.36	8.8	283.35				
		Bangalore	24.00	241.78	12.1	334.77				
Pineapple (Juice)	2½	Calcutta	22.00	188.79	10.3	281.78	No.3 or 46 oz.	2.45-2.85 average 2.65	70.30	31.8
		Bombay	23.50	190.36	9.7	283.35				
		Bangalore	20.75	241.78	14.0	334.77				

* Per doz. unless stated otherwise.

Note :

1. Price of cans in India-Delivery Ex. Calcutta/Bombay and Bangalore-Reformed.
2. Indian cans made from 1.5 lb. pot yield tin coating, hot dipped, plain inside and outside.
3. Wholesale price in USA—taken from the Almanac of the Canning, Freezing, Processing Industries 1961. Prices are of 1960-61 and are canners spot selling price. F.O.B. Factory, subject to customary discounts, including brokerage.

   Average price calculated as the means of the lowest and the highest price.
4. Can prices in the USA—1960 prices taken from the Almanac of the Canning, Freezing, Preserving Industries—.75/.25 electrolytic tinplate, ends .25 lb. plain inside and outside. This is not necessarily the can used for the product, but is the cheapest in the list for the particular size.

6 : Operational Research & Efficiency Studies

THE FOOD PROCESSING INDUSTRY IN THE USA faces very keen competition. The cost of labour is high and the investment involved is large. Therefore, to operate the industry profitably it is necessary for every part of the food processing organisation to operate with utmost efficiency. Operational research has made very valuable contribution in this direction. It has helped to improve the existing techniques, evolve new methods of handling, introduce improved machinery, better inventory control, utilise finance to the maximum possible extent, improve quality of the finished products and finally introduce better techniques of marketing.

A few of the most outstanding examples of operational researches, which have helped the industry, are discussed in this chapter.

It may be helpful if operational research can be defined although this is very difficult as it has no boundaries. The most acceptable definition is as follows :

"Operational research is the application of scientific methods, techniques and tools to problems involving the operations of a system so as to provide those in control of the system with optimum solutions to the problems."

Operational research is concerned with application of scientific knowledge in a number of fields simultaneously. It is, therefore, essential that it should be carried out by a team of specialists drawn from business management, industrial engineering, food technology and statistics.

Several organisations in the United States have operational research teams of their own who continuously keep on studying various aspects of the industrial organisation and keep making their recommendations. Some of the industrialists make use of the private consultation services in the field of operational research and productivity and also take advantage of the facilities available for this purpose at the various colleges and universities. The extension services of the universities undertake operational work free of charge and keep their reports confidential.

One of the largest marketing organisations which maintains its own central warehouse stated that a programme of operational research had helped to save over $77,000 a year by bringing about improvements in the methods of storage, despatch and transportation of goods.

Introduction of the pallet system for warehousing is a good example of the studies carried out by efficiency experts.

One of the largest food processing plants visited by the Team had the installed capacity for manufacturing 700 tons per 24 hours when it first went into production but as a result of operational studies at all stages of processing it was possible to increase the efficiency within a few years to 1,000 tons.

With the increase in the cost of labour, newer and better methods of handling raw materials have to be devised. A good example of this is the introduction of large wooden bins to replace the lug boxes. This has resulted in tremendous savings. These bins are designed to be carried by the stand-

ard fork lift trucks. Also improved equipment has been designed for emptying the bins mechanically.

One of the corn processing plants reported that as a result of operational studies it was able to increase its machine utilisation to 117% as compared to the rated capacity given by the manufacturers. In the initial stages, this appeared to be impossible but a systematic analysis of the operations brought forth a number of recommendations the application of which resulted in large benefits to the company.

The losses in handling of finished goods at the time of loading and unloading operations were quite heavy in the pineapple industry. As a result of a study, it was found that if the loads could be utilised to fit on standard pallets and the cases on each unit-load glued together there would be no chance of their falling off. Today this has become a common practice and the losses have been almost completely eliminated. The sales are also made in unit loads as far as possible.

Operational research studies carried out in a food processing company in the State of Oregon resulted in certain specific recommendations. As a result of this a concern which was losing heavily is now making good profits. The study predicted a profit of $ 50,000 during the first year and $ 250,000 during the next year, which was actually achieved on following the recommendations. The operational research personnel, however, reported that many times the failures resulted because the recommendations were not correctly implemented. Whenever the recommendations were properly followed the results were very good. In fact, many times the result of operational research posed sarious decisions before the management. The resistance to the implementation of recommendations of a study was so strong in one of the plants that three senior executives had to be asked to resign because they were unable to see or even understand the recommendations.

Normally, an experienced operational research team takes between a few weeks to a couple of months for carrying out analysis of all operations in a cannery or a freezing plant. There is a general feeling among some of the large processors that the results of operational research are more practicable and useful when carried out by their own teams rather than outsiders.

One of the operational research reports studied covered specific recommendations on the following points.

1. Prevention of spoilage of raw materials.

2. Improvements in the methods of transporting the raw material.

3. Increase in production by making some changes in the equipment layout.

4. Better machine utilisation.

5. Reduction in the cost of steam production.

6. Training of labour to understand correct machine operations.

7. Reduction in labour.

8. Improvement in the quality of finished goods.

9. Improvement in the yield of finished goods per lb. of raw material used.

10. Efficient utilisation of finances.

11. Preference for truck transport over railways for transportation of finished goods over certain distances.

12. Improvement in the techniques of advertisement.

A programme of operational research in the Indian food processing industry can help to place it on much sounder foundation and make future development possible along modern lines.

7 : Research, Quality Control & Training of Personnel

SCIENTIFIC AND TECHNOLOGICAL research is an integral part of the food processing industry in the United States and Denmark. The Team visited a number of research institutions including two universities. The study proved beyond doubt that research in the field of food technology played a very important role in the development of the industry. It is not possible to give in this report an exhaustive account of the programme of various research institutions but an attempt has been made to draw the attention of the industry and the research institutions in India to the relevant aspects of the subject so as to help in developing a sound programme of applied research in the country.

Most of the food research organisations in USA and Denmark carry out a comprehensive study of the problems in the field of raw materials, technological development required by the industry, equipment design, consumer acceptance and even marketing research wherever possible. On the basis of this study problems are clearly identified and research programmes are prepared with clear objectives and time targets. As a result of this approach, it has been found that the problems are solved expeditiously and there is no difficulty in finding use for the results of the research. It is quite normal to find scientists working in the industry to study on-the-line production problems and in the agricultural fields where raw materials are grown for the industry. India has much to learn in this direction, so that research programmes are not developed according to the imagination of scientists who have hardly ever visited the industry or ever thought of identifying the problems as they exist.

The research work in the field of food science and technology is carried out in the United States of America and Denmark by laboratories set-up co-operatively or individually by the industry, Government organisations and universities including the State Agricultural Experiment Stations and also in the laboratories set up by the manufacturers of food machinery and containers who are interested in serving their customers to the maximum possible extent.

Research for the development of new products, studies in the field of quality control and the training programmes are not isolated from one another and, therefore, each has the opportunity to contribute to the other. This integrated development has been very helpful to the industry in obtaining personnel who are abreast of the new developments and to the research organisations for developing realistic projects for work. The quality control programme has to keep pace with the requirements of the quality conscious consumer and the regulatory controls which keep changing and evolving consistently.

Horticultural research has made valuable contribution to the development of food processing industry and also to the agricultural economies of USA and Denmark

Special varieties of fruits and vegetables have been developed which give high yield per acre and retain good flavour and texture on processing. At present, a considerable amount of research work is in progress in the United States to develop varieties of vegetables which could be mechanically harvested and handled. A good example of this is seen in the development of bush beans to replace the poles beans. The introduction of improved varieties of beans has already resulted in the increase of yield from about three tons to 10 tons per acre. Similarly, improved varieties of strawberries have been developed which give an average yield of 8 to 10 tons per acre as against 3 to 4 tons a few years ago. The average yield of pine-apples per acre in Hawaii is over 28 tons while some of the plantations are able to get as much as 42 tons per acre. Modern developments in fertilisers have played a vital role in this direction. The pest control programmes have gone a long way in improving the quality and yield by preventing insect and microbial damage.

Technological research has resulted in the development of a large number of new products including by-products from industrial waste. Today it is possible to manufacture 300 products from citrus fruits alone. The pineapple industry is able to recover 50% of its sugar requirements from the fruit waste. The manufacture of bromelin enzyme from the heart of the pineapple plant and amino-acids from fish waste are some of the outstanding examples of the results of by-products research. All this has helped the industry to hold the price line while the cost of raw materials and labour is going up continuously.

It is not possible to list a large number of projects on which the research work is being carried out at present in the United States and Denmark but a few projects observed by the Team are as follows :

1. Flavour components of the various products.
2. Nutritive value of fish fat.
3. Accelerated freeze-drying of fruits, vegetables, meat and fish.
4. Use of antibiotics to reduce processing time.
5. Asceptic canning.
6. Irradiation.
7. Food additives.
8. Development of new machinery and equipment designs.

9Consumer acceptance studies.

Co-operative Research

The National Canners' Association in the United States has done very valuable service to the industry. This organisation not only acts as a watch-dog for the industry to protect its legal interests in Washington, D. C. but carries out a very useful programme of research in its Central and Zonal laboratories. Most of its laboratories are located in the food processing areas to assist the industry with their day-to-day problems and to pick up research problems as they arise. The research projects of the Association cover studies on colour and flavour of processed foods, development of new equipment, processing technology, retention of nutrients, sanitation, waste disposal and consumer acceptance. It has been possible during the last few years for the Association to develop techniques for mould counting, insect fragment counting and chemical analysis to determine spray residues in the raw materials. Detailed instructions on the use of these methods are supplied to the industry from time to time. The large amount of studies carried out by the Association on the processing time and temperature for various foods are well-known to the processors. Their bulletins on this subject are considered standard texts not only in the United States but also in many parts of the world. The Association has also carried out a large amount of extension work and published literature, such as "Canned Food in Human Nutrition" which has become a standard textbook for home science colleges and schools. The National Canners' Association not only carries out research work in its own laboratories but sponsors a number of projects in various other organisations such as the

universities and State Agricultural Experiment Stations.

The Team strongly feels that there is need to develop a similar strong Association in India for the industry which could set up a co-operative research organisation to undertake research work on behalf of the industry. Any new research organisation must, however, take into consideration the personnel problem as there is tremendous shortage of competent applied scientists in the country.

The Pineapple Research Institute in Hawaii and the Meat Research Laboratory in Denmark are two of the most outstanding examples of co-operative research effort by the Industry. It has been recognised that the Pineapple Research Institute has saved the industry from extinction on a couple of occasions during the last half a century and has contributed valuably towards the development of the desired quality fruit which would give high yield per acre and reduce wastage in processing. Today it is possible to grow over 17,000 pineapple plants per acre. Each fruit weighs approximately 5 lbs. and has a sufficiently elongated shape which lends to the mechanical cutting, coaring and slicing operations with maximum efficiency. The Institute has worked out fertiliser and pest control programmes for the pineapple growers which are kept strictly confidential.

The Meat Research Laboratory in Denmark which was started by pooling the resources of the entire meat processing industry has helped to lay down standards for the quality of raw materials used for various products. Their research programme includes constant improvement in processing of meat. The laboratory workers carry out on-the-line study of the problems in the industry, find solutions for them and apply the results directly where they can produce the maximum impact. The Institute has also developed quality control standards to be followed by the factories. At the time of the Team's visit 40 of the trained technologists of the laboratory were actually working in the meat processing plant all over Denmark. The laboratory also has a well organised training school for the education of personnel for the industry.

Some of the major contributions of the Meat Research Institute are as follows :

(i) Improvement of the keeping quality of bacon by improving transport conditions for pigs to the slaughter houses.

(ii) Working out presumptive tests for storage life of beef carcasses by the use of harmless micro-organisms.

(iii) Introduction of the use of liners for luncheon meat pack in cans.

(iv) Improving the techniques of slaughtering pigs by the use of carbon dioxide gas.

(v) Development of jaw puller from the head of slaughtered pigs.

The results of the work done are not only published in the form of reports for the industry but are discussed at meetings of industrial technologists held with the staff of the Institute from time to time. It is quite obvious as to how it has been possible for the Danish Meat Processing Industry to maintain the highest possible quality standards in the world and compete on the international market.

Industries Own Laboratories

All the large canners have their own research and quality control departments. Their programmes cover product development, nutrition, studies on spray residues, horticultural improvement, development of new machinery, maintenance of sanitation standards and continuous on-the-line quality control. Some of the food processors who have a large number of factories maintain a Central laboratory for most of the research programmes but have small quality control laboratories located in each one of their factories. The small laboratories follow the quality standards laid down by the Central laboratory which receives copies of their daily report and makes recommendations from time to time for further improvements. The vigilance of the quality control staff was observed at its maximum in the

factories manufacturing infant and baby foods. An example of this can be seen from the control maintained by one of the baby food manufacturers at each one of the following stages of operation:

i) Every shipment of raw material is checked for microbial load.

ii) Samples of the products are drawn before sterilisation for bacteriological tests at intervals of every three hours.

iii) Samples of sterilised products are drawn at intervals of every two hours.

iv) The equipment used in various operations is also tested for bacteriological contamination three times a week.

With the above rigid control it is possible to maintain the processing times and temperatures quite low and to retain the natural flavour and nutritive value of the product to the maximum possible extent. It is quite obvious from the above as to the direction in which the course of our progress also lies.

The Team visited two plants of the largest food machinery and manufacturing organisation in America and observed that they also have well organised research departments which constantly study the problems of the industry and design machinery and equipment to meet the changing demands of their customers. They carry out some of the experimental work in collaboration with their customers. At one place, it was observed that a machinery manufacturer was operating its new experimental bean harvestor on the fields which were under the control of a large canner. At another place the use of a new tomato harvestor seemed to have met with a considerable amount of success. Machine harvesting would, however, require growing tomatoes of special varieties which would not be damaged by mechanical handling and would ripen at the same time as it is necessary to pick the entire crop at once by mechanical means.

The large can manufacturers in America have carried out valuable research to improve the processing techniques for their customers. A can manufacturer had established its research department as early as 1906. One of the major activities of this laboratory is to test all the raw material used in the manufacture of containers. The second major activity is to improve the quality of containers and the third to develop cheaper raw material so that the containers may be supplied to the canners at more economical rates. As a result of the work of this laboratory it has been possible to reduce the prices of containers or at least hold the price line when the costs of raw material and labour are rising steadily. Many different types of lighter weight tin plate with or without lacquers, with differential tin-coatings have been developed. Some of the other developments worth mentioned are the composite containers and aluminium cans. It will be very helpful if the can manufacturers in India could undertake similar studies to develop cheaper containers for the Indian market. Taking into consideration the climatic conditions and the handling methods in India, the results achieved in America may not be applicable unless they can be confirmed in this country.

The entire can conveying system used in the canneries has been developed by the can manufacturers. The introduction of continuous retorts has necessitated a considerable amount of studies on time and temperature for processing. It has been carried out by the food machinery manufacturers. Recent studies on the use of steam jet for obtaining vacuum in the food cans has resulted in the elimination of exhaust box.

Government Research Organisations

The United State's Department of Agriculture has under its control a number of regional research laboratories which study the problems of each region with a view to develop raw materials and processing techniques. These laboratories have also made valuable contributions towards the development of by-products. The Federal Government also finances a number of research projects in the agricultural research stations of various States. The laboratories under the control of the Food and Drug Administration not only carry out analysis of products for the purpose of regulatory

control but also have their own research programmes to study the toxicity of various chemicals and to develop more effective methods for implementation of the Food and Durg Act.

Two of the leading universities, the University of California at Davis and the Oregon State University at Corvallis were visited by the Team. It was observed that most of the research programmes in their laboratories are geared to the solving of industrial problems. A number of post-graduate research projects are actually financed by the industry. In addition to this the university staff is engaged in research on a number of fundamental problems which also have bearing on the applied research. Thus the new knowledge developed does not take very long before it can find use.

Training of Personnel

A number of leading universities in the USA provide comprehensive courses in the field of food technology leading to Bachelor's degree. The training provided to the students is very comprehensive and practical because the staff of the university is constantly in contact with the industry through their research and consultancy programmes. The Extension Services of the Universities keep the industry informed of the new developments and in turn bring back problems of the industry to the research workers. Post-graduate courses provide facilities for specialised research and training in the field of food science and technology. A number of fellowships and assistanceships are given by the industry to the post-graduate students so that it may be possible for them to continue higher education for a few years and complete research projects undertaken by them. Thus the industry benefits from the research and the students manage to get their post-graduate degrees.

The extension services of a number of universities frequently hold specialised short refresher courses for the technical and management personnel working in the food processing industries. Programmes for these courses are jointly prepared by the universities and the industry.

In this respect the research and training institutions in India have much to learn from the USA and Denmark so that their programmes may become realistic and the training provided to the students may assume sound practical bias so that as soon as the graduates or diploma holders complete their courses they would be ready to assume responsibilities in the industry.

Special mention must be made here of the excellent quality of middle-level personnel working in the American and Danish food processing industry. This includes production supervisors (foremen), mechanics and field-men. As a result of the sound training given to them it is possible for the industry to operate at a high level of efficiency. India needs to make every possible effort to develop personnel of this category. The National Productivity Council, Research Institutions, universities, training centres and the industry should co-operate for producing the desired results in this direction.

8 : Marketing & Distribution

EXPORT IS THE KEYNOTE OF DANISH FOOD processing industry and, therefore, every possible effort is made to expand the international market for food products. There is a considerable amount of opposition to Denmark's joining the European common market as it is feared the food processing industry would receive a setback. Through the export boards and the offices of the various larger Danish organisations in foreign countries the marketing of Danish products is well organised. The Danish processors have adopted the most modern packaging standards and national quality marks have been assigned for their butter, cheese, meat and other products. This has helped in establishing a considerable amount of prestige all over the world. The Britain is their largest single buyer. Danish manufacturers make products according to the requirement of different countries. In some countries, the Danish meat products, butter and cheese have distinct and preferential market. The export of canned meat carries a subsidy of 5 per cent. The pork export board has evolved a bonus scheme for export to the USA. The export price of Danish butter is 20 to 25 per cent lower than the internal price of butter. In Denmark everyone is conscious of the fact that the country has to depend on export and hence it has hardly been necessary to enact legislation for the purpose.

In the United States the distribution and marketing have completely changed over the last twenty years. It is reported that 85 per cent of food is now sold through super markets many of which are part of a national or a local chain. This has resulted in elimination of the middleman and reduction in prices of many items.

The prices of farm produce have remained at the level of 1948. This has been possible because of the rise in agricultural productivity. The development has necessitated reorientation of marketing and distribution by the processing industry. The chain stores prefer to sell goods under their own brands. They get products packed by various manufacturers all over the United States or sometimes even abroad. As they have the means of distribution which seem to control the choice of the consumer they are in a very favourable position. Even the well-known brands have had setbacks as they are now forced to absorb much larger advertising and sales expenditure than they did when they could market all their products under their own label. Most of the units visited by the Team packed goods under various labels. One of the processors reported that 70 per cent of the canned foods manufactured in the country is now bought by 12 organisations who have nation-wide sales and distribution and that this is resulting in a very tight squeeze on the processors as well as the primary producers.

The distribution pattern of the products having changed the super markets call for goods as and when they are required. This means that from the warehouse maintained by the processors, products go directly to the sales counter. This increased the burden of the processors who have to have large warehouses and larger finance

facilities from the banks. The super markets provide the service to the consumer in many respects by enabling him or her to buy all the requirements under one roof. A detailed description of a super market organisation will give an idea of the scale of its operation.

A visit to one of the stores in the chain was a valuable experience in the techniques of merchandising. The American marketing organisations believe that advertisement takes the goods to the consumer while merchandising takes the consumer to the goods. It is the art of merchandising which is seen at its top efficiency in these stores. The store visited by the Team had 7,000 items on display for sale. Most of the goods sold in the store were obtained by the chain under its own brand although some nationally advertised proprietory brands were also sold simultaneously. The goods under the store's own brand were 15 to 20 per cent cheaper than the proprietory brands because there was no question of paying high advertisement charges and overheads on them to the manufacturer. The chain spends two million dollars a year on its advertisement programme which amounts to only 10 per cent of its total turnover.

The shelves in the stores are very conveniently arranged. The customer, usually the housewife, enters the store through a turn-style entrance which is so arranged that no one can go out of the entrance. After that she can pick up a small wire basket trolly normally referred to as the "buggy" in America and push it through lanes of shelves on both sides of which the merchandise is arranged. The display of the goods is so convenient and attractive that normally a customer purchases 20 to 25 per cent than what she needs. For example, next to the macaroni shelf is a shelf full of Italian wines. After the housewife picks up some macaroni she is immediately reminded that Italian wine goes well with it; therefore, she picks up a bottle. Similarly, different types of syrups are kept next to flours meant for preparation of pan cakes, waffle-mix and other breakfast foods. The price is very clearly marked on each item.

The only staff present, besides the cashiers, is that which makes sure that the store is kept clean and the supplies were regularly replenished on all the shelves.

It is estimated that 20 to 25 per cent of the customers change shops for purchases in search of bargains and, therefore, a special bargain counter is provided at the beginning of each row of shelves. Most of the bargain material is sold at cost or a little above cost. Once the customer enters the store to pick up one or two bargain items he or she immediately moves on to the next shelf and purchases a few other items.

On completion of shopping, the customer pushes the "buggy" to one of the cashiers, who picks out each item, weighs it on an automatic scale and rings off the amount of money on the cash register. The goods are put neatly in new brown paper bags and placed into a used cardboard carton and delivered by one of the assistants to the customer's car. Most of the super markets are located outside towns. This is because they are able to get a lot of open space for construction. Parking of cars is a major problem in America and, therefore, there are hardly any super markets or large stores located inside towns. Most of them have shifted to the outskirts of the major residential areas. Normally, a super market has to provide two or three times as much area for parking as for the construction of the store itself.

Super markets usually operate on a gross profit margin of 15 to 20 per cent. The highest profit items are the liquors and the lowest profit ones the dairy products and flours.

The architecture and designs of the super markets are most impressive and provide for plenty of lighting. In Southern California, where the temperature goes up as high as 100° to 110° F, most of the super markets are air-conditioned. A number of super markets are open until 10 P.M. and some of them work 24 hours. The minimum wage paid to the workers, assistants and cashiers is $ 1.75 per hour and the maximum $ 3.50. In addition to this they earn by way of overtime. The normal overtime wage is 50 per cent

above the wage rate but on Sundays and holidays it is double. Most of the techniques and methods of merchandising and marketing followed by the super markets may not be of much use in India, but the display techniques and presentation of products may be utilised to a great advantage.

It is interesting to note that the changes in the marketing methods have brought about drastic alterations in the design of labels for processed foods. There is very little writing on most of the labels. The letterings are large and clear. The colour contrasts are sharper. This makes it possible for the customer to read the label from a distance without making much effort and find the product he wants in the stores. The American label today is designed for a self service.

Centralised Purchase & Warehousing

The development of large marketing chains has necessitated organisation of centralised purchasing and warehousing on a gigantic scale to feed the large number of stores in every area.

The Team visited the headquarters and central warehouse of the largest regional chain store organisation on the west coast of the USA. This organisation has 54 super markets in a 100 mile radius and a large central store constructed on a 25 acre site. Its total sales amount to $ 200,000,000 a year. The organisation employs 3,000 persons. It is estimated that the average cost of setting up each store in the chain is around $ 5,000,000. This giant marketing organisation has the following departments :

1. Employment : This department looks after staff, their problems, negotiations with the Union, interviews and training programme. In addition, it looks after the employees credit union, which has a borrowing of $ 500,000. Loans are given to the staff members for purchase of cars, houses etc. on a very reasonable interest.

2. Security Department : This department looks after cases of theft, shop lifting, bad cheques given by the customers and overall security of the stores and the central warehouse.

3. Legal Department : A group of qualified lawyers, maintained by the company, looks after matters relating to State and Federal laws affecting the marketing organisation. It also looks after contracts for purchase of various materials and legal matters relating to land, building, equipment, etc.

4. General Accounting : This department looks after the maintenance of accounts relating to sales, purchase, salaries and taxes. Accounting is done on I. B. M. electronic machines. In 1961, the organisation paid $ 4,000,000 taxes exclusive of Income-tax.

The marketing organisation operates on a gross margin of 21 per cent plus 1 per cent for publicity. The net margin is 3 per cent on the turnover of 15 times the equity capital before payment of tax.

5. Telephone Department : This is one of the most efficiently maintained departments. It receives daily 3,000 calls. Only one operator looks after the entire department which has 250 telephones. The out-going calls do not go through the operator.

6. Post Office : At an average seven hundred and fifty pieces of items are posted every day and seven deliveries are made daily for the post received.

7. Store Planning Department : This is one of the largest departments of the company. It looks after the planning of new stores, construction of building, equipment layout and arrangement of items for sales. A store normally carries 7,000 items. The cost of construction of a store is as follows :

Building	$ 400,000
Fixtures	$ 250,000
Inventory	$ 750,000

8. Advertisement & Public Relations Department : This department looks after the designing of advertisement material, labels, publicity contracts with newspapers and other agencies. At an average, seven different advertisements appear every week in 132 newspapers. The advertisement budget is $ 30,000 a week which amounts to 1 per cent on the turnover.

The organisation has a carpentry department which manufactures signs and silk screen posters for all the stores in the chain.

9. Buying Office : This department is divided into several sub-sections as follows :

a) Meat and liquor purchase,

b) Fruit and vegetable purchase,

c) Test kitchen where every product purchased is tested for its consumer acceptance and cooking quality,

d) Grocery department, which purchases two billion cases of canned foods and 50 million packages of frozen goods every year, and

e) Non-food section which looks after the purchase of items like combs, tooth brushes, blades, etc.

Magnetic tape recorders are used for sending orders.

10. Produce Department : This section looks after the purchase of fruits and vegetables and their re-packing in consumer size packs. It has a cold storage at 55° F and 90 per cent humidity, which is controlled by spraying of water from the roof.

The central store of the organisation maintains stocks of 400 million cases, Weekly receipts and shipment are 140, 000 cases.

The stocks are completely turned 18 times a year; the attempt now is to turn 20 times.

Normally ten days supplies are kept on hand, and the stocks are very carefully rotated on the basis of first come first go. The date of receipt of stock is marked on pallets. The railway loading platform has arrangement for loading and unloading of seven railway wagons at a time. An equally large truck loading platform has hydraulic parking areas for adjusting truck heights so that the fork lift trucks can be used. One third of the merchandise comes by railway wagons. It is estimated that one man can unload a railway car, at an average, per day. Normally four persons work on unloading and loading of cars and finish the work in two hours. It takes one week to transport goods by railway wagon from New York to Los Angeles over a distance of 3,000 miles and it takes three days from Chicago to Los Angeles over a distance of 1900 miles.

11. Delicatessen Department : This department looks after packing of cheese and other delicatessen in consumer size packs. Automatic balances are used for weighing the packs, and stamping of the prices on them. The central warehouse also maintains 7000,000 cases of non-food items in stock. Bread, milk, meat, butter, etc. are supplied directly to the stores. Out of a total of 5,000 items, only 2600 are kept in the central store.

The entire roof of the storage building has a false ceiling of wood which serves as an insulation to keep temperature down during summer and also prevents freezing of food during winter.

The central store has a very efficiently organised tow cable car system for the transportation of goods. Fork lift trucks are used for unloading trucks and railway cars and for stacking the goods in the warehouse. The building has loading and unloading platforms on three sides.

Fire fighting equipment is built into the building and water sprayers go on automatically by pressing a button.

The most effective advertising medium is the television. This takes the product and its quality right within the purview of the house-hold and makes a very effective bid in creating demand and showing how and why a product is acceptable. The nutrition standards, dietetic habits and more important, the consciousness of calories in diet affect all aspect of food processing industry. We observed that the low calorie foods were becoming more prominent and certain foods which offer advantage from dietetic point of view such as fish was gaining popularity ground.

Cottage cheese, cultured butter milk and cream, low fat milk with high solids-not-fat, low calorie speciality foods are more of the new lines of interest.

Some mention may be made of the popularity of gift coupons for sales promotion. Some of our consumer goods would do well to adopt this approach as there seems to be a larger customer appeal in the system.

It was reported that distribution and sales promotion cost between 5 to 7 per cent. The

incidence of freight is also comparatively very little. One of the reported figure is 15 to 20 cents per case (Rs. 0.80 to 1.00) for a distance of 250 miles. The distribution is mainly through trucks.

The new pattern of distribution as observed in the United States has some advantages and perhaps could be adopted under Indian conditions.

Our distribution is through many channels. The estimated expenditure of distribution and sales in India is 25 to 30 per cent. If centralised markets can be operated in some of the metropolitan centres, it should be possible to reduce this expenditure considerably. This may also help in controlling prices of commodities which are in short supply.

In the United States consumer education seems to be the keynote in developing the food processing industry. The visit to the National Canner's Association in Washington D.C. attracted our attention to the consumer education service which the National Canner's Association provides to the industry. Large number of recipes are developed and sent out to high schools, home economics departments of colleges, radio and T.V. net works. Emphasis is also laid on the role of processed food in human nutrition. This programme suggests ways and means of utilising different processed foods and their importance in the diet.

The food preservation industry in India needs to start a programme of consumer education in a moderate way, if necessary, by showing the housewife how different products can be utilised by her. This is necessary because Indian housewives are bound by traditional barriers and do not seem to be aware of the advantages of processed products. Most of the products manufactured at present in India are according to the western style and, therefore, some of them are not suitable for use in the culinary habits in India. It is necessary that we should develop new recipes for the manufacture of products which will lend themselves for easy adoption in the preparation of Indian dishes. We must also attempt to create an aesthetic sense in the presentation of food and lay due emphasis on the nutritional aspects of what is being consumed. The development of subsidiary and protective foods has to play an important role in improving the dietary pattern. We feel that associations of the industry and the development agencies, both official and non-official should be able to contribute valuably to this programme.

9 : Food Laws & Standards

THE OPERATION OF FOOD LAWS AND standards was studied by the Team only in the United States of America. In this connection a visit to the headquarters of the Food and Drug Administration and the United State's Department of Agriculture in Washington, D. C. was very useful. An effort was also made to study the manner in which the industry complied with the regulations and made use of the standards.

The Food, Drug and Cosmetics Act was passed by the United States Congress in 1938 and was amended in 1954, 1958 and 1960 to cover pesticides, chemicals and colours, respectively. An important feature of the 1958 amendment is that it puts the burdon of proving the safety of the additives on the manufacturer.

The provisions laid down under the Food and Drug Act are mandatory while the grade specifications laid down by the United State's Department of Agriculture are voluntary.

In the United States of America each State has its own food laws but they are effective only within the State boundaries. As soon as any goods enter the inter-State commerce, the Food and Drug Act becomes applicable. The enforcement of the regulatory control under the Act is looked after by the Food and Drug Administration set up under the Department of Health, Education and Welfare with its head office in Washington, D. C. and zonal offices distributed throughout the United States. This has made the law uniformly effective all over the country. As against this, although the Prevention of Food Adulteration Act in India was passed by the Parliament, its enforcement is left to the States and the local authorities. This has resulted in the lack of uniformity in effective application of the law in different parts of the country. It will, therefore, be most helpful if the enforcement of the prevention of the Food Adulteration Act can be taken over by the Central Government and a chain of regional offices organised for its uniform application. This will be in the interest of the consumer as well as the industry. It was reported to the Team that the public and the industry in America are well satisfied with the manner in which the Food and Drug Act is enforced. The centralised control avoids interference from local influence.

The products imported into the United States have to comply with the provisions laid down under the Food and Drug Act. If the product does not conform to the legal requirements its entry into the country is prevented by the customs authorities. The appeal in such cases can only be made to the Food and Drug Administration whose decision is final.

Procedure for laying down Standards

The tentative standards may be proposed by the United States Food Commissioner at his own initiative or whenever a request is received from the industry. The draft standard is published and comments received are reviewed by the Commissioner with the help of competent staff. After that a tentative standard is formulated and public hearings are held to discuss the subject in detail. This provides a very democratic forum to the industry and the public to present their points of view before the authorities. This procedure is indeed lengthy but it makes the standard very comprehensive and practical. It was stated that a number of the standards

were accepted quite easily but in case of a few it took as much as ten years to finalise. Introduction of a similar system of laying down standards in India would be very helpful.

Laboratories for Regulatory Control

The main laboratory of the Food and Drug Administration is located at its headquarters in Washington, D. C. In addition to this the administration has 18 zonal centres with well equipped laboratories distributed all over the United States. These laboratories employ well trained technical staff who are also aware of the problems of industrial operation. If a similar chain of inspection laboratories could be started under the prevention of Food Adulteration Act in India it would be very helpful to enforce the law in a fair and practical manner.

The Team had the opportunity to study the work of the Microbiology Division of the Food and Drug Laboratory in Washington, D.C. The laboratory had made a comprehensive study of the microbiology of raw materials used for processing. One of their recommendations is that the tomato processing industry should obtain its raw material from the areas where the crop grown is free from mould contamination in order to comply with the mold count regulations laid down under the law. A similar recommendation has also been made to the strawberry processors in the State of California. One of the leading manufacturers has taken this recommendation into consideration for locating a new unit.

A careful check is maintained on the sanitation standards of milk products. It was reported that in spite of all the sanitary precautions taken by the industry they have discovered staphylococci in cheese. dry milk and some bakery products although such cases are rare. Semolina is the second item in which contamination has been observed.

A fairly large number of chemical additives are permitted in the United States. The authorities have made careful study of these chemicals and have laid down limits for their use. Such an enlightened approach to the subject by the Central Committee for Food Standards would be very helpful to the industry in India.

The regulatory control laboratories in the USA also undertake research work to improve the techniques of analysis or develop new ones. They have made a valuable contribution by developing techniques of micro-analysis for detecting very small quantities of chemical additives and spray residues in food products.

It was observed that the Food and Drug Administration laboratories have some difficulty in obtaining staff as the industry is ready to offer higher salaries and better prospects.

U. S. D. A. Standards

As stated earlier the standards laid down by the United States Department of Agriculture are voluntary but they are used widely. The raw material standards are used for marketing of fresh produce and also for the purchase of fruits, vegetables, meat and fish by the manufacturers. In fact, the standards are incorporated in the contracts signed between the growers or suppliers and the processors, and have been very helpful to improve the quality of raw material.

The grading work is done by persons trained and licensed by the United States Department of Agriculture. The services of private licensed graders can be utilised on payment of their fees. Some of the canners employ the graders full time during the season. The Department of Agriculture keeps a close watch on the work of the graders and can terminate their licence if the work is not found satisfactory. Training and licencing of private graders in India is strongly recommended to the Directorate of Marketing and Inspection as it would help to eliminate unfair practices in the sale of agricultural produce. One of our major problems is the quality of raw material. If the consumers of fresh produce and the food processors can obtain high quality raw material they should be willing to pay for it.

The standards for finished products are also quite extensively used. It is reported

that 40% of canned and 80% of the frozen foods are graded according to the U. S. D. A. standards. These grades have a very good standing in business transactions. Whenever the super market organisations or large consumers purchase the goods from the manufacturers, they specify the grades and pay the prices accordingly. This is done in spite of the fact that the grades are not marked on the label in most cases. Usually, if the product conforms to Grade A, it is marked on the label but that is not the case when it is only of the standard quality.

The United States runs a large number of school lunch programmes which are supervised by the Department of Agriculture. It was observed that the powdered milk products for supplies to the schools were being manufactured under the continuous inspection system of the U. S. D. A. although the dairy industry is generally controlled by the State laws. This made it possible for the product to be used in a number of States without difficulty.

Efforts are made to make the grade standards as objective as possible by reducing the human factors, for example, colour discs and colorimeters are used for determining the colour standards. A puncture tester has been developed for testing maturity of pears. It is not possible to go further into the details of the objective methods of testing but it may be worth mentioning here that efforts should be made to adopt similar methods in India to eliminate the possibilities of error and to reduce controversy. Score cards are extensively used for the grading work.

The standards laid down by the United State's Department of Agriculture are accepted by the Defence Services for purchasing their food supplies. They issue standards only for those products where the U. S. D. A. standards do not exist.

Whenever necessary, ad hoc committees are set up under the Food and Drug Administration of the Agricultural Marketing service of the United States Department of Agriculture to advise the authorities on the formulation of standards. There are no permanent committees for this purpose.

Continuous Inspection System

The United State's Department of Agriculture runs a voluntary continuous inspection service. Many of the large food processors make use of this service. There are 33 centres set up by the Department of Agriculture to provide inspectors to the interested manufacturers on payment of $ 5.50 per hour. Some States also have similar services for which they charge on a per case basis. The Team observed the working of the continuous inspection service in some of the factories. The inspector on duty regularly examines the samples of raw material as it is received and picks up samples of the product from various places on the production line. Finally he performs cut-out tests on the finished product. His report is sent to the U. S. D. A. authorities and copies are given to the Management every day.

The meat and poultry processing industry uses the continuous inspection service very extensively. In fact, the Team was informed that there is hardly any meat processing factory in the USA which does not have the continuous inspection service.

A development which may be of special interest to the Indian fish processors was observed in the sardine industry in the State of Maine. Due to continuous deterioration of the quality of products the industry had begun to go out of business. Therefore, the manufacturers decided to set up a sardine fund to introduce continuous inspection and grading system to improve the quality of the product. This fund was ultimately handed over to the State. The standards w hich were first laid down by the industry in 1928 were made mandatory in 1958 through a State legislation. Thus the quality control helped to save the industry and place it on a firm foundation. The Indian fish processing industry should take this as an example and start laying down its own standards which could ultimately be converted into a proper law. This will particularly help the export trade.

It is quite obvious from the discussion that the continuous system has many advantages and has been able to assist the industry in a very effective manner. The Team, therefore, recommends that the authorities incharge of enforcing the laws for regulating the operation of food industry in India should make a detailed study of the continuous inspection system in the United States of America and adopt it after suitable modifications.

The Agmark standards have been enforced in India for quite some time for the quality grading of dairy products and also some other agricultural produce. A beginning has also been made jointly by the Indian Standards Institution and the Agmark authorities, to formulate standards for canned fruits and vegetables. This unified approach by both the organisations to develop standards for the industry is a step in the right direction. There is need for similar co-operation between the P.F.A. and the F.P.O. authorities in order to avoid duplication of their efforts which confuse the industry and the public. Such difficulties are solved in the United States by holding inter-departmental discussions, from time to to time, to work out clearly the jurisdiction of each department. This avoids duplication of effort and makes the enforcement of the law more effective.

In Denmark, the Team visited two specialised laboratories. One of them looked after the inspection and certification of meat products and the other did similar work for the fish products. The entire meat and fish processing industries send their samples to the respective laboratories for examination and certification. The products which conform to the standards are permitted to use the national quality mark DANA. The meat and fish export boards pay towards the expense of running these laboratories. Some of the products in Denmark are also marked under the Danish Control Organisation set up by the processors, consumers and the Government. The quality mark of this organisation is DVN.

Before ending the subject on food laws, it may be helpful to mention a few more observations which may interest the Indian food processing industry and the law enforcing authorities. The standard of sanitation in most of the new processing plants in Denmark and the United States is of very high order but some of the older plants leave much to be desired in this direction. The law enforcement authorities, however, take a reasonable view of the problem. So long as the minimum hygienic standards can be met they do not take unnecessary objections. While most of the processing equipment which comes directly in contact with the food product is made of stainless steel, some of the other plants still use wooden or galvanised iron equipment. It was pointed out in one of the units that there was no objection to the galvanised iron as the product under manufacture was almost neutral and, therefore, there was no danger of its reacting with the metal. Several operations are conducted in the open but there is no objection to this from the law enforcement authorities because there are no flies around. None of the factories visited had any fly proofing screens on the doors and windows. The fly control programme is carried out in a very comprehensive manner by spraying their breeding places with insecticides. The emphasis on prevention rather than cure has brought forth good rewards. Fly proofing can never be a good success as the doors have to be opened hundreds of times daily ; besides, it adds to the ventilation problem in a warm country like India. The Indian industry and the law enforcing authorities have much to learn from this. Mechanical material handling and the speed of operation add to the problem of sanitation. It is quite difficult to keep the mass of conveyors clean unless special precautions are taken. One of the factories had continuous washing arrangement for the conveyor belts with water containing five parts per million of free chlorine. In some of the factories the clean-up gang, which operated intermitantly could barely keep pace with the speed of waste collection during the working hours. The standard of hygiene in the plants processing milk products, baby food, meat products and poultry products as well as in the food freezing industry is considerably higher than the fruit and vegetable

canning units. The object of mentioning these observations is not to draw any comparison but to highlight the practical considerations which sometimes outweigh certain legal requirements in order to operate the industry efficiently. The U.S. Government takes a reasonable attitude towards these genuine difficulties so long as the raw materials and the finished products can meet the standards of hygiene and sanitation. The law enforcing authorities in India must also take into consideration the problems of the food processing industry and formulate their codes only after careful study of the difficult conditions under which the industry has to operate.

10 : Industrial Relations

A CONSIDERABLE AMOUNT OF ATTENTION is given in the United States and Denmark to the industrial relations. Every possible effort is made to create the psychological conditions under which the workers can contribute their maximum efforts towards productivity.

In several of the industrial units visited by the Team it was found that excellent facilities were provided for the workers' meals. Some of the organisations served free tea during the 10 minutes break every morning and afternoon. In Denmark the largest can manufacturer supplies free lunch to all the workers and the staff in well maintained and efficiently run dinning rooms.

The worker management relations are also good. In one of the organisations visited in the United States of America the wife of the company's Chairman took keen interest in solving personal problems of woman workers. The relations with the trade unions are very good in both the countries visited. The Teams of contract are discussed by the management with the union officials and the decisions arrived at are satisfactory for both the parties. In the United States of America the "closed shop" system operates. This means that a worker who joins the factory has to join the recognised union first in order to become eligible for employment. This adds to the bargaining capacity and prestige of the union. The piece work system is accepted only after it has been carefully discussed between the management and the union so that there is no possibility of any dispute. In arrriving at these agreements every possible care is taken to make sure that the productivity aspects receive their due importance and the workers get their fair wages. Payment is generally made to the workers according to their efficiency. For this a special pattern of payment known as the Bidault system has been worked out. Under this an efficient worker gets higher wages than an inefficient worker ; thus providing incentive for increasing efficiency.

The figures given by one of the units in the USA showed that 33% higher production was obtained with 25% higher wages. The wages of the workers have increased to $ 86.00 (Rs. 407.80) per week as compared to $ 20,00 (Rs. 95.00) per week since 1939. However, the real buying power of the earnings has increased only by $ 25 (Rs. 118.75).

Rationalisation in industry is welcomed by the employees to a very large extent, both in Denmark and the USA. Mechanisation is progressing at a tremendous speed and every attempt is made to utilise machines in favour of man. Wages being high, such a movement is inevitable. The index of labour requirements for a particular unit of output came down from 100 in 1939 to 76 in 1950 and the number of production workers per unit of output fell from 100 to 71. During the same period the output per man hour increased 31.6% and the rise in output per production worker was 39.7 per cent.

India has much to learn from Denmark and the United States in establishing good industrial relations with due emphasis on productivity. This will require education of the workers and better understanding of certain problems by the management. Although programmes directed towards this objective have been started by the Government of India, the results produced so far

have hardly been satisfactory. One of the major obstructions to any progress in this direction is the low level of literacy in India and lack of scientific and technological atmosphere to make the workers think along modern lines of productivity and scientific control. The Government must take industry and the labour unions into confidence for developing joint programmes specially suited to Indian conditions for improving the industrial relations which would bring greater economic returns to the industry and also improve wages and the working conditions of the labour. Perhaps it may be necessary for the white collar workers to take more active interest as they are a comparatively more conscious and educated section of the employees in the industry.

11 : Summary & Recommendations

THE PRODUCTIVITY TEAM ON FOOD Preservation Industry visited Denmark and the USA after having completed an in-country study tour of the productivity problems of the industry in India. Some members also visited Japan.

The Team is thankful to the National Productivity Council for the opportunity to study the productivity problems under the auspices of the United States Agency for International Development. The programme of the Team was well organised and covered the field of study to the maximum possible extent.

Management

The overall performance of the Food Preservation Industry in Denmark and the USA showed a high level of productivity. It was observed in all branches of the Food Preservation Industry that the large units are increasing their size whereas the smaller ones either merge to form more economical units or go out of business. This has pertinence to our Indian conditions where units are not economical and do not make efficient use of the capital invested.

Many organisations have more than one production unit with the top management as well as the sales and purchase departments highly centralised. However, for effective working of the individual units, a large amount of power is decentralised and the management at the factory level is given adequate freedom of action and sufficient resources of men, material and finance to complete the task efficiently. It was significant to observe that technologists, engineers and research scientists enjoy high status in many orgnisations. The management in India should take effective steps to improve the status of technical personnel and give them greater freedom in decision making.

Attempts are constantly made to develop and introduce new products in order to utilise plant capacity which would otherwise lie idle, especially during the off-season, and to overcome the difficulties which may be created due to changing food habits, and consequent decrease in the demand of existing products. The manufacture of by-products from factory waste has helped to increase the economy of plant operation. In many places integrated production units have been developed to fully utilise the selected raw material for the manufacture of main, subsidiary and by-products. This has resulted in substantial economy and higher productivity.

The management takes active interest in planning and procurement of the required raw materials. Agreements are signed on standard contract terms for purchase of vegetables, fruits and other commodities well in advance of the season. The contract terms are beneficial to all concerned and should be adopted in India.

The Team observed three important factors responsible for the high level of productivity in the food preservation industry.

(i) High yields in horticulture and animal husbandry.

(ii) Efficient materials handling as the key note of plant operation.

(iii) Vigilant management through sound budgeting, inventory control and full utilisation of the capacities at all levels of operation.

Management of Co-operatives

The successful growth and development of the co-operative movement is mainly due to consciousness of their members and efficiency of the management. The elected Chairman and Directors lay down policies while the day to day management is left to the executives.

In Denmark, the co-operative dairy and meat industries are well organised. At present there is a move to merge smaller dairies to form large scale units for better economy of operation and quality control. This is an important point to be considered in relation to the various dairy schemes in India.

Export is the life line of Denmark. Separate Export Boards have been constituted for various commodities. They undertake direct export on behalf of their members and are doing excellent work. Our Export Promotion Council may benefit from their experience.

The co-operatives in the United States have been a great success in many fields. They are exempted from Income-tax but the individual members are also liable to pay the tax on their income. The co-operatives are treated only as agencies or commission agents.

One of the milk-co-operatives in the mid-western region of the USA has effectively organised a large number of units in several States. The inter-state link has proved very successful. It is recommended that such a link-up may be tried in India.

The processing plants run by the co-operatives control the field operations of their members and advise the growers on the use of fertilisers, spray chemicals, time of harvesting etc. in order to improve the quality and increase the yields. A major campaign should be organised along these lines in India.

Raw Materials

The industry based on agricultural produce as its basic raw material has a different concept of growth and development in the countries visited. The fundamental approach is that the raw materials are meant for the industry, and not the industry for raw-materials.

The Team is convinced beyond doubt that the growth and development of the food processing industry depends largely upon the development of raw materials. The present programme in this field in India is very disappointing and, therefore, there is an urgent need to make all possible efforts for the development and procurement of suitable quality raw materials for the industry.

The development of special varieties for processing has revolutionised the food processing industry in Denmark and the USA. The work done by the National Canners' Association, State Agricultural Experiment Stations, Universities and even some leading manufacturers revealed the magnitude of this problem to the Team.

Although the urgency of progress in this direction has been recognised in India, very little progress has been made. The Team strongly feels that an imaginative and bold programme of action must be undertaken immediately. Some of the intensive agricultural development programmes can perhaps be made to take interest in it. International agencies like F.A.O. Ford Foundation, U.S. Agency for International Development and others may also be approached to assist with the study.

The following steps are particularly recommended :

(i) Organisation of Workshops on Food Processing Industry where those connected with the growing of raw materials for the industry would get the opportunity for proper training.

(ii) Invite teams of experts on sub-tropical fruits and vegetables to assess the problems and recommend the direction for future development.

The Food Processors are the largest single buyers of agricultural produce and are, therefore, in a position to substantially influence many aspects of growing. This should also be possible in India.

The raw materials are available to the industry in the USA and Denmark at highly competitive and reasonable prices. This actually is the pre-requisite for developing a sound food processing industry. The industry in India suffers on this score as it has to compete against the fresh goods market for obtaining its supplies of raw materials. This picture must change if the industry is to progress.

The Danish auction system facilitates wholesale marketing of perishables and brings good return to the producers. The Team recommends the establishment of an auction system on these lines as it would be very beneficial to Indian growers.

Location, Plant Layout—Equipment & Service

Almost all the food processing industries are located at the source of raw material supply. Because of this the industry can maintain an effective control on the supply and quality of the raw materials.

It is unfortunate that most of the food processing units in India are located in marketing centres. Every possible effort must be made to re-locate our industry in agricultural areas and to develop direct control on growing and supply of the raw materials.

The buildings are specifically designed for the food processing industry and its special needs relating to loading and unloading of raw materials and finished goods, proper drainage and waste disposal. Special care is taken to provide ventilation and lighting based upon legal standards. An effort has been made in Denmark and the USA to invest as little as possible on the buildings and to utilise the space with the maximum possible efficiency. During construction of the building great care is taken to make sure that no problem arises with regard to sanitation. Many food processing units store their raw material in open sheds with pillar supported roofs. Large storage bins are also constructed in the open.

There is much for us to learn about factory construction from the United States and Denmark. Efficient operation will never be possible if industrial units are located in residential premises as is the case with many small organisations in India. Strict sanitation standards cannot be maintained in such buildings. It is strongly recommended that proper building designs should be prepared according to the production capacity desired and supplied to those interested in modernising their units. This work could be undertaken by the Small Scale Industries Services Institutes in co-operation with C. F. T. R. I. and experienced architects.

Many fruit and vegetable processing units have their own cold storages for storing raw material and ripening it under controlled conditions. The fish and meat processing units also have quick freezing facilities which help them to prolong their season, sometimes throughout the entire year.

Such storage facilities would help the Indian industry very much as many crops have very short seasons when prices are economical and supplies are abundant.

Services like water, steam and electricity are laid out in such a manner throughout the plant that they can be tapped wherever necessary along the production line without interfering with any of the operations. In one place a co-operative steam supply system was observed. Such a development may be very helpful in India particularly if the food processing industry is located in an industrial estate specially meant for the purpose.

It is recommended that proper specifications should be developed to assist the industry in planning the layout of these

services taking into consideration all the safety measures.

The most impressive feature observed in the food processing industry abroad was the highly efficient system of materials handling. Specially designed conveyors are used for the movement of raw materials, empty containers, prepared material and the finished goods. Most of the machinery used is continuous type. Mechanization has revolutionised the industry helping to cut costs and increasing efficiency.

At the present stage of development of the Indian industry it should be possible to introduce the use of conveyors for handling raw materials, finished goods and also for the preparation lines in some cases. It is recommended that the industry, through its associations, should contact the conveyor manufacturers and discuss the problem with them so that suitable materials handling equipment can be expeditiously developed in the country. It may not be possible to use automatic lift trucks at present but trolleys with lift arrangements could be used to a great advantage.

Production

The level of productivity is very high in Denmark and the USA and it is most apparent in the manufacturing departments. This is primarily due to the very high cost of labour and the high speed of production. Stoppage of work for a few minutes can result in very heavy losses.

India does not face problems of this nature at present but the time is not far when the wage rates will go up and the emphasis on efficiency, speed and quality will make it imperative to adapt to our conditions the techniques of productivity observed by the Team abroad.

Production planning begins in the field. The date of harvesting is decided jointly by the production and field departments. The latter are in complete control of growing, harvesting and transport to the factory. Every effort is made to see that the time lag between harvesting and processing is reduced to the minimum. The distances over which the raw material is transported varies from a minimum of 10 miles to a maximum of 40. Special lug boxes or bins are used for handling the crop so that damage is avoided. The quality control which begins in the field continues until the product is finally processed and stored. Wherever the raw material has to be stored under refrigeration and ripened under controlled conditions it is looked after by a separate department. Samples from all the raw materials received at the factory are taken according to an established pattern and the examination report submitted expeditiously to the production Superintendent as well as the Accounts Dept. Payment is made according to quality, maturity and grade of the produce and the processing conditions are also adjusted accordingly.

If the Indian industry is to progress it must adopt a rigid system of quality control of raw materials, as well as an on-the-line inspection system. After all, the finished goods can only be as good as the raw materials which go into it.

The high level of automatisation requires use of specialised equipment for the manufacture of each type of product. The equipment, therefore, has to be completely changed from season to season in order to handle different raw materials and to manufacture different products. All the equipment used in the processing plants is installed in such a manner that it can be easily removed. The services are organised to suit different types of production lines. The maintenance of equipment is exemplary and it is not unusual to find an item of equipment in perfect condition after 20 or even 30 years of use.

It is not possible for India to consider complete automatisation at present but we must learn the value of line operation and utilise the technique to attain optimum efficiency with the equipment available in the country.

Every food processor in the United States and Denmark makes efforts to organise off season operation to cut down overheads by manufacturing products from stored raw materials. This opportunity is also utilised to develop and market new products for meeting

the changing tastes and requirements of the consumer.

The climatic conditions in India are favourable to organise round-the-year production but initiative must be taken to develop new products to suit the consumer demand in India.

In this chapter the manufacture of the following products has been given in detail :

i) Processing of pineapples including manufacture of by-products from waste
ii) Canning of peas
iii) Canning and freezing of beans
iv) Canning of corn
v) Packing and processing of citric fruits
vi) Manufacture of pectin
vii) Packing of Mandarin Oranges
viii) Brining of cherries
ix) Dehydration of prunes
x) Manufacture of jam
xi) Manufacture of baby foods and junior Foods
xii) Fish processing and manufacture of by-products from waste
xiii) Meat processing
xiv) Packing of poultry
xv) Packing and processing of eggs
xvi) Dairy industry

It is hoped that the detailed information will be useful to the Indian food processing industries for raising the level of their productivity and improving the quality of their products.

The speed and the technique of handling raw materials contributes towards the quality of the finished products.

It is, therefore, strongly recommended that the Indian Industry should make every possible effort to introduce at least items of euipment which would improve the quality. For this purpose the Government of India should give special machinery import licences to the industry. Without this it will not be possible for the industry to manufacture goods which could compete on the foreign market and earn the much required foreign exchange. Simultaneously efforts must also be made to develop machinery and equipment in the country. For this purpose, the C. F. T. R. I. should set up a design centre to develop equipment suitable for Indian conditions and give the necessary assistance to the manufacturers of food machinery.

Containers

The most widely used containers for packing food are tin cans and glass jars or bottles. Plastic containers are becoming popular but present certain problems which are discussed. Single service containers of plastic and aluminium foil are becoming popular specially for packing jam and certain other pasty products. Denmark also uses cardboard containers for packing jams and marmalades.

With the acute shortage of tin plate efforts should be made to introduce plastic and cardboard containers in India wherever possible, provided their prices are competitive. The development of plastic containers, however, depends upon the manufacture of high density polyethylene in the country.

The prices of tin, glass and plastic containers are much lower in America and Denmark as compared to India The details of this are given in the chapter.

It is quite obvious that the Indian industry cannot compete on the foreign market unless the price of containers is brought down to the same levels as in the USA or Denmark and the quality, specially of glass and plastic containers improved. Also in order to increase consumption of canned food products at home, the prices must be reduced. It is, therefore, strongly recommended that containers should be made available to the industry, delivered at the factory, at international prices.

The container manufacturers in Denmark supply printed cans even if the order is as low as 15000 to 50000. This has increased the attractiveness of the containers

and added to the productivity by eliminating the labelling operations.

Indian containers manufacturers must provide similar facilities to the food processors.

Very few products are packed in the United States in cans entirely made from hot dipped tin plate. The use of electrolytic tin plate (0.75 lb. coating per basis box) is quite common. Products are also packed in containers made from differentially coated tin plate.

It is recommended that as a first step the use of electrolytic tin plate with 0.75 lb. coating per basis box should be introduced both for civilian use and supplies to Defence. Containers made from this tin plate are considered quite safe for long storage of products and are comparable in almost every respect with those made of hot dip-plate. Investigations should also be carried out on the use of tin plate with lesser coating substance.

It has been possible for the American can manufacturing industry to hold the price line by introducing the use of double reduced tin plate.

Investigations should be undertaken to study the possibilities of using this type of tin plate for packing food products in India. The Government may also consider the possibility of making this tin plate in the country.

Two types of internal lacquers, sulphur resistant and acid resistant are quite commonly used. A number of lacquers have also been developed by suitably combining the two.

Most of the can manufacturers are located in the food processing centres and, therefore, the containers do not have to be transported over long distances.

Efforts should be made in India to encourage the development of the container industry in processing areas.

Most of the can stock is held in the premises of the food processing factories at the cost of the container manufacturer who pays rent for the space occupied. The container manufacturers should offer similar facilities to the food processing industry in India. They should store the containers in the premises of the processors instead of holding them in their own factories. This will help to overcome the failures of container supplies during the season which occur quite frequently due to difficulties of transport. For this special banking facilities should not be difficult to arrange.

Operational Research & Efficiency Studies

Operational research is defined as the application of scientific methods, techniques and tools to the problems involving the operations of a system so as to provide those in control of the system with optimum solutions for the problems. It covers a wide field of study and hence is usually carried out by a team of specialists drawn from business arrangement, industrial engineering, food technology and statistics. These studies have helped the American Food Processing industry to raise their productivity substantially. Examples of the successes achieved in this field are given.

It is essential that the Indian food processing industry which operates at very low level of efficiency at present should make use of the knowledge in the field of operational research to utilise the available resources of men, material and equipment at a level of efficiency which would bring the maximum results. This will go a long way to reduce the cost of production and improve quality.

Operational Research studies in the USA are undertaken by private consultants and the extension services of the universities. The latter carry out these studies free of charge as they are supported by public finance. They are able to assist small scale industry which cannot afford to maintain experts of their own. Some of the large industrial units have their own operational research teams under an industrial engineer. They are of the opinion that the results of study carried out by their own teams are more effective than these by outside experts.

As the level of operation of the Indian food industry is quite small it will not be

possible for the industrial units to have their own teams or to pay heavy fees to the consultants. Therefore operational research work should be taken up in the country by the National Laboratories like the C.F.T.R.I. so that the industry could call upon them for assistance. A small beginning has been made in this direction but much needs to be done.

A number of new developments such as the design of new materials, handling equipment and other machinery in the USA are the outcome of recommendations of operational studies. These recommendations are based on actual conditions in the industry and are not based on any guess work. Therefore, they are able to bring the best possible returns.

In order to develop suitable equipment for Indian conditions, operational research studies will be extremely useful.

Scientific Research

Scientific research in the United States and Denmark has developed as a result of the needs of the industry, so that their existing processes may be constantly improved and new ones developed. The scientists carry out a major portion of their research work on the problems of industry which they obtain after a programme of careful on-the-line study in various industrial units. They spend a lot of their time in the factories for this purpose. Each technological research project has its time target and an estimate of expenditure to be incurred on it.

It is strongly recommended that the research programmes in the field of food technology in India should be oriented to the needs of the industry and based upon the actual problems as they exist and must take into consideration the level of technology required. In addition to this the food research organisation in the country should be able to provide a sound consultation service. This is very essential because the Indian industry is too small to afford such facilities independently.

Research on raw materials has resulted in developing suitable varieties of fruits, vegetables and breeds of animals for the industry. These programmes of research are carried out with the active participation of the processors.

It is essential that India should develop similar programmes of research. The attention of the Indian Council of Agricultural Research and Departments of Agriculture in every State is particularly required in this respect.

Modern technological developments in food processing are revolutionising the industry in the United State. The developments in the field of containers and packaging are of particular significance.

The C.F.T.R.I. can play a very effective role in this direction provided its programme is developed in collaboration with the industry. The attention of the CSIR is particularly drawn in this respect.

In the United States of America a large amount of research work is done with the financial support of the industry in the agricultural research stations of various States and also by the United States Department of Agriculture in its own laboratories. Some of the large food industries have their own research departments with excellent facilities and competent personnel. A considerable amount of research work is undertaken by the National Canners' Association in its own laboratories. The Association also finances research projects in other laboratories.

The food industry in India can profitably consider the possibility of starting a co-operative research association which could undertake a programme of research on a contract basis for the industry. The Central government is ready to give ⅓ of the capital expenditure and 50% of the recurring expenses for the establishment of such an organisation. The real problem, however, would be to obtain competent staff as the country is very short of trained personnel.

Most of the training programme is carried out in direct collaboration with the industry. A number of post-graduate research projects are financed by the industry and refresher courses are regularly held with the direct participation of the industry.

The development of such a programme is most essential for the progress of Indian food industry. The urgency of holding the short courses which would bring the industrial management and technical personnel up-to-date with the new developments cannot be over emphasised.

Through the programme of applied research the industry has perfected a very comprehensive system of quality control. Food processing is a highly competitive field in Denmark and America. Therefore, unless the products manufactured are of the highest quality, they cannot stand against their competitors on the market. The United States Department of Agriculture has helped to evolve techniques of quality grading of raw materials and finished goods which help the industry and protect the consumer.

The Indian food processing industry must also make efforts to develop a quality control system adapted to our conditions assuring manufacture of high quality finished products.

Marketing Industry

Super markets or chain stores sell 85% of the food products in the United States of America. This development has revolutionised the marketing and distribution of food products in that country. Many of these stores prefer their own brand names and purchase their products from various manufacturers directly, eliminating the middle-man and cutting down prices. This has resulted in a major set back to some of the best known brands. Such a development is a very remote possibility in India.

Super markets have been responsible for the development of completely new techniques of advertising and display. The designs of the labels for example, have been so changed that it is very easy for a customer to locate any product. "Self-service" has made this necessary. India can make use of some of these techniques to an advantage.

The super markets control their purchasing very carefully so they do not have to hold large stocks, thus forcing the manufacturers to do extensive warehousing. They, however, purchase large stocks when attractive discounts are offered and hold them in their own warehouse.

The Indian industry can learn from this as the cost of warehousing in large cities is very high. The distribution has to be planned so that the minimum investment is blocked.

A detailed description is given of the organisation and functioning of a super market company visited by the Team. It may be of interest to the manufacturers and distributors of food products in India.

M a r k e t i n g techniques emphasise merchandising and advertising to reach various types of consumers. Indian marketing organisations can adopt the techniques with advantage although the emphasis may have to be quite different.

The speed of distribution is very fast in America. It takes less than a week for good wagons to reach New York from Los Angeles a distance of 3000 miles. This is significant in view of the short shelf life of some of the products. The cost of distribution is also much lower in America than in India.

Our Government must make special efforts to increase the efficiency of railway transport and give rate concessions to the food industry in order to encourage its development in the growing areas. The American Railways are willing to accept goods packed in cardboard cartons at their own risk. While the packaging specifications in India are so rigid, that it is difficult to find packing which would be acceptable to the railways for transport of food products at their risk. A drastic change in the railways' packaging specifications and handling procedures will benefit both food industry and the consumer.

Food Laws & Standards

The Team had the opportunity to study the functioning of the Food and Drug Administration of the United States and found a considerable amount of similarity as well as contrast between its functioning and that of the prevention of Food Adulteration Act in India. The officials in the United

States felt that the federal control of the law has been very helpful to the development of the industry as well as to protect the consumer interest. In addition to the federal Act the States also have their own laws in USA. The federal act applies only to the goods which enter interstate commerce.

It is, therefore, recommended that the control of the prevention of Food and Adulteration Act, for all purposes of operation, should be taken over by the Central Government in India.

The enforcement authorities of the Food and Drug Act lay emphasis on the educational aspects of the problems. According to one of their important programmes they study each specific industry separately and ascertain the problems in detail with a view to making improvements and also developing efficient methods of law enforcement. It is recommended that the law enforcement authorities should carry out such studies in India.

The Food and Drug administration of the United States runs a number of laboratories at various centres. These are manned by personnel especially trained for the purpose.

It is recommended that a number of regulatory control laboratories should be started in India with well trained personnel who are aware of the working of the industry.

The procedures for laying down the standards in America are quite similar to those followed in India except that they follow certain democratic practices evolved out of their own experience, for example they hold public hearings where the industry can present its case.

Non-mandatory assistance such as the grading of agricultural produce has helped to improve the quality of raw material and has made a major contribution to improving the agricultural economy.

The continuous inspection system introduced by the USA Department of Agriculture for quality control of food products needs to be carefully studied by the Indian authorities so that the American experience may be helpful to us in developing suitable inspection system for our industry.

The fish processing industry in the State of Maine developed a system of quality control by evolving standards at its own initiative and then requested the State to pass the law to enforce the standards and introduce a system of inspection. The fish processing industry in India needs to develop a suitable system of quality control which can form the basis for the development of a Government control order.

The Food and Drug Administration takes a very practical view of the existing problems of the industry in exercising the power vested in the law. There is need for developing such an attitude in India.

Industrial Relations

A considerable amount of attention is given to industrial relations. Psychological conditions are created under which workers can make maximum contribution to productivity. India has much to learn in this direction. Success can only be achieved and proper co-operation established between the workers and the management when both are adequately satisfied with the operating conditions.

The conditions of industrial workers in America are far better then those in India. Although the production has been rising the number of workers has remained steady. The wages are continuously going up and vary between $ 1.25 and $ 2.50 per hour, depending upon the nature of work and the area in which the industry is located.

Every industrial unit visited by the Team had carried out a programme of work study. The large units have their own work study teams while the rest employ outside experts to use the services available with the universities for the purpose.

Maintenance of the maximum level of efficiency is the key note of the management.

Hardly any significant studies have taken place in this direction in India. The rising

wage bill and the increase in the cost of raw material are beginning to throw some light on the subject.

General Recommendations

The study of the Team has been very extensive. In order to obtain maximum advantage of the knowledge of productivity, it is very necessary that a programme of intensive study be planned for the personnel engaged in specialised work in the food industry. For this the study of the following subjects is recommended :

i) Growing of raw materials including development of special varieties and increasing the yield per acre.

ii) Production planning and plant operation.

iii) Operational research and scientific control.

iv) Consumer education and marketing.

It is hoped that in time to come the National Productivity Council will be able to arrange the suggested training in India and abroad.

APPENDIX A

Terms of Study

The Team will study productivity problems relating to the preservation of fruits, vegetables, milk, fish and meat products.

Circumstances permitting, a special study will also be made of accelerated freeze drying, freezing, cold storage and dietetic foods. The following terms of study were assigned to the Team :

Problems of Study

1. **Management and Financial Control**

   Administration: Financial Organisation; costing.

2. **Raw Materials**

   Development; Pre-Packaging; Transport; Storage.

3. **Production**

   Preparation
   Filling
   Closing
   Processing
   Lebelling
   Storage

4. **Plant Layout and Equipment & Services**

   Location; Construction (type); Selection and Installation of Equipment; Power; Water; Steam; Effluents.

5. **Operational Research and Efficiency Studies**

   Machine Utilisation; Work-load; Man-Machine Relations.

6. **Research and Scientific Control**

   Development Work, Plant Engineering; Research at Scientific Institutions; Expenditure on Research; Quality Control.

7. **Food Laws and Standards**

   Federal and State Laws; Voluntary Standards; Development & Formation of Standards; Sanitation Requirements.

8. **Containers**

   Cans; Glass; Flexible.

9. **Marketing and Distribution**

   Sales Promotion; Publicity and Consumer Education.

10. **Industrial Relations**

    Employer-Employee Relations; Wages and Incentives.

11. **Training of Supervisory and Management Personnel.**

APPENDIX B

THE ILLINOIS CANNING Co.
Hoopeston, Illinois

GREEN PEA CONTRACT
Fowler, Indiana Plant

This contract executed in duplicate and made and entered into this.....day of..... ..... by and between the Illinois Canning Co., a corporation, Hooposton, Illinois, hereinafter called the Company and the Grower whose name and signature appear above and below, hereafter called the Grower.

Witnesseth

The Company agrees to purchase and the Grower agrees to sell the green pea crop covered by this contract at the prices and in accordance with the terms and conditions hereafter set forth. The Grower hereby agrees to plant.....acres of Alaska peas on suitable land properly prepared and free from thistles or other noxious weeds using only pea seed furnished by the Company for which he will be charged and agrees to pay .06c per pound and to care for and deliver in accordance with the Company's instructions to Company's plant at Fowler, Indiana the acreage and variety of green peas at the price listed below:

Alaska Peas

Tenderometer	*Price per ton*
90 and under	102.50
91 to 95	92.50
96 to 100	87.50
101 to 105	85.00
106 to 110	78.50
116 to 120	66.50
121 to 125	61.75
126 to 130	57.00
131 to 135	52.25
136 and over	42.75

Deduction of gross weight for dirt or weeds in excess of two per cent.

It is mutually agreed that in case Grower is unable to harvest and deliver crop as fast as it matures, the Company will furnish labour and equipment to assist the Grower and charge the Grower whatever expense is incurred thereby.

It is agreed that Company shall be liable for harvesting and delivering crop, if weather conditions make use of equipment in fields physically impossible.

All peas must be green, tender and fit for canning. Where any thistle, noxious weeds, hard or discoloured peas are mixed with peas delivered, the Company reserves the right to reject the same or fix the price thereof.

The Company agrees to use every care in supplying pure seed of high germinating quality but does not guarantee the crop. Company agrees to furnish inoculation for which Grower agrees to pay fifty cents per acre.

Grower agrees to call for and receive the seed at Company's factory at a reasonable time before planting and to sow and deliver the crop at such time as directed by the Company. It being understood that the planting schedule is an important and necessary arrangement to be strictly followed.

Grower agrees to harvest the crop when directed by Company, regardless of yield, unless permitted to do otherwise by written consent of the company. If Grower fails to harvest and deliver crop as instructed by

Company's agent, then the Company reserves the right to harvest and deliver the crop at the expense of the Grower. Grower agrees that Company representative may enter upon Grower's premises any time during the duration of this contract for any purpose pertaining to the crop, including chemically treating or dusting for pea aphid. The necessity for chemically treating or dusting is to be determined by Company in which case Grower will be charged and agrees to pay for material used and Company will furnish equipment and driver.

The Company further agrees to furnish bags for the seed and for the crop which may go to seed but all bags to be promptly returned and if injured or lost, the Grower to pay for the same.

The Grower agrees to pay for any other charges there may be, for commercial fertilizer, inoculation, bags labour, etc. Settlement for peas shall be made as soon as reasonably possible after the close of the packing season as it is possible for the Company to compute such settlement, provided no legal notice preventing such settlement has been received by the Company and providing land owner furnished written authority to Company if settlement is to be made with anyone except said owner. Either of the parties to this agreement may be released in part or wholly from the above contract by reason of fire, explosion, strikes, riot civil commotion or other circumstances beyond their control upon immediate notice to the other party of such occurrence. It is further mutually agreed that if factory is rendered in operative due to any other cause, the liability of the Company to the Grower shall in no case exceed $30.00 per acre covered by this contract. This contract is subject to all present and future Government restrictions and regulations as to price, acreage, and other matters affecting the subject matter of this agreement.

In witness hereof the parties have hereunto set their hands and seals the day and year first above written.

Method of Settlement_____

_____

_____

GROWER THE ILLINOIS CANNING Co.

_____ (Seal) _____ (Seal) _____

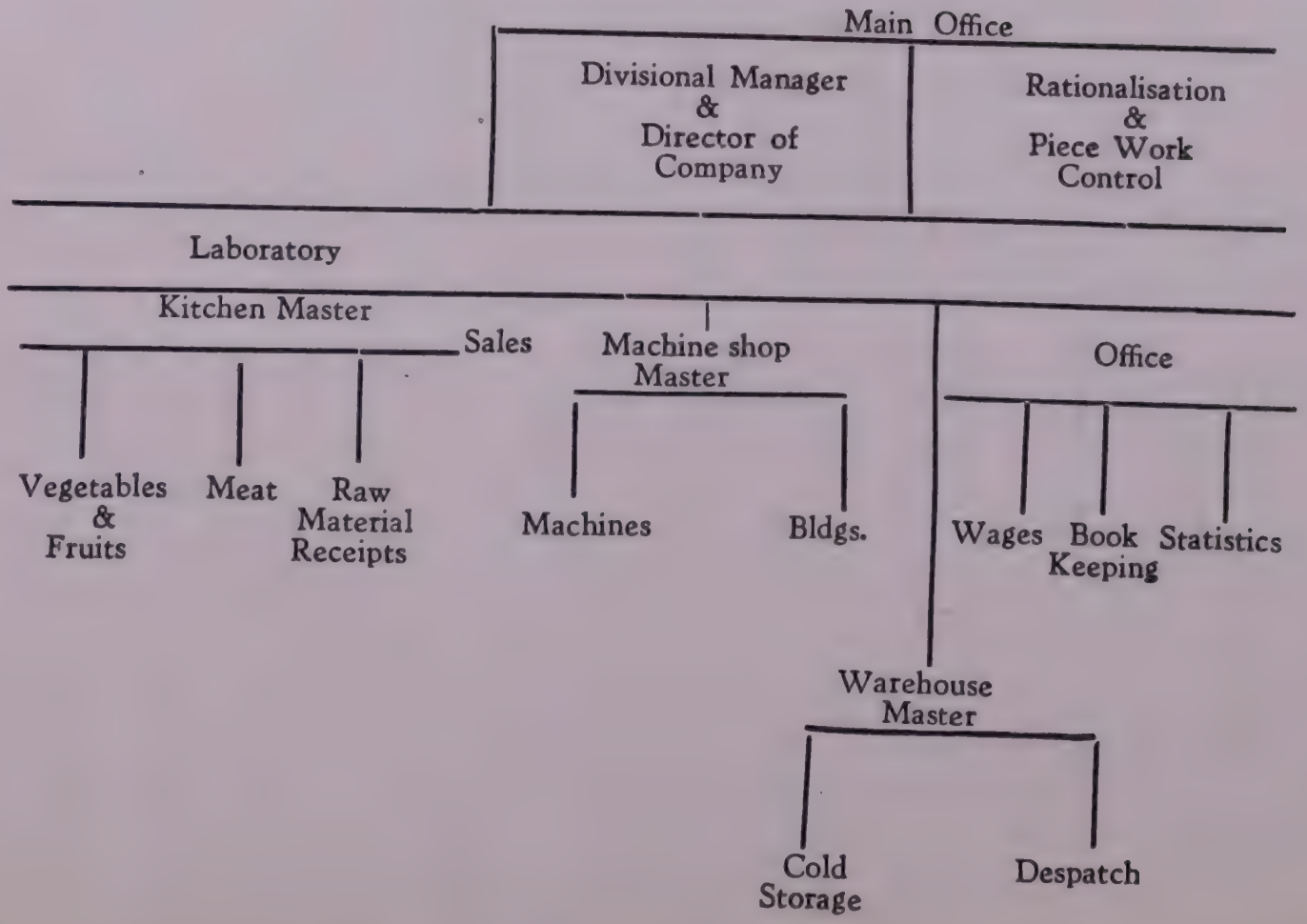
Address_____ Name of Landlord_____

Telephone_____

Distance from factory in miles_____ Address_____

APPENDIX C

Organisation Set-up of a Large Manufacturer



APPENDIX D

Standard By-Laws for Co-operative Dairies as Approved by the Federation of Danish Dairy Associations

1954

Article 1

Name, domicile and purpose

The name of the association shall be..... Co-operative Dairy; the domicile of the association is the Parish of.....

The purpose of the association shall be to receive, process and dispose of the milk produced by the co-operative members as well as other activities in connection with this, in such a way as shall be most profitable for the co-operative members.

Article 2

Admission of members

Every milk producer situated within the natural territory of the association is entitled to be admitted as member. On joining the association applicants concerned shall sign the register of members and are thereby bound by the by-laws of the association as these are validly enacted at any time. No one shall be entitled to deliver milk to the association before he has signed the membership form.

Article 3

Obligations and rights on change of ownership, new tenancy or cessation of tenancy

On change of ownership or tenancy, or on the cessation of tenancy, the new owner or tenant may succeed in the rights and liabilities of his predecessor when both parties have signed a written declaration to this effect and handed it over to the president of the association. Upon the receipt of such a declaration, the association shall refer all matters to the new owner or tenant.

If the association has received no such declaration within one month of the change the former owner or tenant shall be held liable to pay his share of the gross liabilities of the association, whereas he shall only be entitled to one quarter of the amount outstanding to his credit on his account with the association as per the latest statement of accounts; of article 8 (one-quarter of his share in the total net assets of the association).*

The Board of Directors shall be authorized to make exceptions to the above rules in respect of tenancies running at the time these rules come into force.

On the death of a member his estate of his heirs shall take over his liabilities.

Resignation

Any member wishing to resign must give notice in writing two months in advance of the end of financial year (this does not apply to change of ownership, new tenancies

* The regulation set out in brackets only applies if the association does not keep separate co-operative accounts for each farmer; otherwise it is cancelled.

(In calculating the amount of capital assets accruing to the association the dairy is assumed to be in function),

or cessation of tenancy). In such cases the farmer shall be paid one-quarter of his share in the assets of the association according to the balance sheet, and shall pay his full share in the gross liabilities of the association.

Irregular resignation

A member resigning without giving notice as prescribed shall be responsible for the whole of his share of the gross liabilities of the association and shall forfeit his right to any assets standing to his credit on his account with the association (shall have no claim on whatsoever capital assets may be owned by the association*).

Furthermore the association is entitled to demand compensation—to be decided by the Board of Directors—of up to 10% of the butter-fat-value of the said members, milk deliveries during the previous financial year, multiplied by the number of years from the day he resigns until the date to which notice according to the by-law might be given.

Article 4

Obligation to deliver milk

Every member shall be obliged to deliver to the association all the milk which is produced by his healthy cows and which is not used for his own domestic purposes or for feeding his animals or for direct sale from the farm (the latter, however, only being allowed to the extent laid down by the Board of Directors).

Failure to comply with the rules for delivery shall be regarded and treated in the same manner as an irregular resignation; of Article 3.

Quality of milk

All milk shall be delivered in a clean, fresh, well-cooled and unadulterated conditions.

It is forbidden to deliver milk from sick cows, and members are not allowed to deliver milk from a cow until two days after its calving.

If the manager of the dairy considers that the milk delivered does not comply with the above conditions, it is his duty to return it.

Delivery of adulterated milk

If a member delivers adulterated milk, he shall be liable to pay damages for any loss incurred, and if the adulteration has taken place with his knowledge he shall be liable to a fine. The amount of damages and the fine shall be decided by arbitration (of Article 15), provided agreement cannot be reached amiably. The Court of Arbitration is further competent to exclude the said member of the association whereby he loses rights in the association, and is bound to his share of the gross liabilities of the association.

Cessation of deliveries

If a member has not delivered milk to the dairy during a period covering the notice required for resignation—except in cases mentioned in the beginning his membership of the association shall be regarded as terminated. He shall then automatically lose any claim on assets standing to his credit on his account with the association (his share in capital assets of the association *) and shall pay his share in the gross liabilities of the association.

Article 5

Transportation of milk

The transportation of milk is provided for by the association, unless any other arrangement is agreed upon with the Board of Directors.

The members shall deliver their milk at the time and place fixed by the Board of Directors to fit in with the milk lorry's route.

* The regulation set out in brackets only applies if the association does not keep separate co-operative accounts for each farmer; otherwise it is cancelled.

(In calculating the amount of capital assets accruing to the association the dairy is assumed to be in function).

Article 6

Payment and settlement of accounts

The full value of butter-fat of all milk delivered is distributed weekly on the basis of its content of butter-fat.

Reduction

All other payments to members are made on the basis of their milk deliveries. The association's estimate of weight and fat-content shall be accepted as the basis valid for calculation of payments.

Accounts for milk deliveries shall be settled every...weeks. Milk which is proved by means of the methylene blue test (or any other method of testing the quality of milk) to be sub-standard, shall be paid for at a reduced price, to be fixed by the Board of Directors.

Article 7

Skim milk, buttermilk and whey

Skim milk, buttermilk and whey which is not used by the association for any other purpose shall be returned to the member—the quantity being proportionate to the quantity of whole milk delivered by him—at a price fixed by the Board of Directors according to its utilization value.

Article 8

Loans & liabilities

Capital necessary for the purchase of new fixed assets or for changes of buildings can be obtained by loan, according to the decision of the General Assembly. For all debts contracted by loan, including guarantees undertaken by the association, the members shall one and all be regarded as guarantors. The members shall be mutually responsible for such loans in proportion to the amount of milk they have delivered during the last ten years.

The whole amount paid in by a member on his resigning from the association as his share of the gross liabilities shall be used by the association as payment against its long-term loans.

Savings account for new equipment

At the end of each financial year, the association shall, if so is decided by the Board of Directors, pay into a special account an amount corresponding to a maximum of 1% of the association's turnover in that year, to be used for new equipment and/or working capital. The amount on this account is included in the co-operative account mentioned below.

Co-operative account

On the basis of its balance-sheet, the co-operative dairy shall establish a co-operative account, which represents the capital in hand of the association. On the co-operative account each member shall have his special individual account corresponding to his share in the association's capital in hand. Separate account of each member shall be calculated on the basis of his milk deliveries to the association during the previous ten years. The amount thus credited to the account of each member is redeemed in annual parts over a period of ten years.

Each year an amount is added to the co-operative account corresponding to the difference between the amount still outstanding on its balance-sheet after payment of the above amortisation and the actual capital in hand of the association. The amount thus entered to the credit of the co-operative account is distributed among the accounts of the individual members in proportion to their milk deliveries during the preceding year.

After redemption of the full amount originally credited to the separate account of the individual member, the sum to be paid out during the following financial year shall be equivalent to the first amount credit after the account has been opened. During the following year again the sum payable shall be equivalent to the amount credited during the second year after the account was opened, etc., etc.

Article 9

General Assembly

The supreme authority of the association shall be the general assembly, to which all members are admitted.

Notice of meetings and agenda

The statutory general assembly shall be

held each year in the month of October or November, and notice shall be sent in writing to all members at least eight days before, together with the agenda. An extract of the annual balance-sheet for the preceding financial year shall be sent out in time for the members to receive a copy on the day before the meeting at the latest. Motions sent in by members for inclusion on the agenda of the general assembly shall be sent in, in writing, at least 14 days before.

Annual report, balance-sheet and elections

At the statutory general assembly a report shall be given of the activities of the association during the preceding year, and also a statement of accounts and a balance-sheet for the same period to be decided by the assembly.

The general assembly shall also elect the Board of Directors, the President, and the auditors.

Extraordinary meetings of the general assembly

An extraordinary meeting of the general assembly shall be held whenever the Board of Directors consider it necessary, or when at least one-fifth of the members send in a written application to that effect, indicating the agenda to be discussed.

Notice of such extraordinary meeting shall be sent out at least eight days in advance.

Chairman of the general assembly. Voting

The general assembly shall elect a chairman of the meeting to conduct the proceedings and decide upon all matters regarding the voting.

Every member or his proxy has one vote in general assembly. No one shall act as proxy for more than one member. All matters are decided upon by majority excepting questions relating to change of by-laws which are to be decided by a majority of at least three-quarters of those present, and at least half of the members being present or represented at the meeting. If the latter condition is not complied with, a new general assembly shall be called with eight days' notice, in which case three-quarters of those present (irrespective of the number of members represented) shall be sufficient to form a quorum.

Article 10

Duties of the management committee

The Board of Directors are to take care of the business of the association in accordance with the by-laws, and, together with the manager, supervise that the milk and milk products are treated properly according to the economic interests of the association, regard always had to the quality of the products. The Board are responsible for the management of the assets of the association in the best possible way.

Election of Board of Directors

The Board of Directors shall consist of 5 members to be elected at the statutory general assembly for a period of two years; after the first year, two of the members to be selected by lots, shall retire from the Board, and thereafter alternately three and two members each on the following year. Re-election is permitted, but no member shall be obliged to accept re-election. Each year the general assembly shall elect the President of the association from among the members of the Board.

Procedure

The Board of Directors shall elect a vice-president and a treasurer.

Meetings of the Board of Directors

All resolutions passed by general assemblies or by the Board of Directors shall be entered in a protocol, which is to be signed at each meeting by the members of the Board and at the general assembly also by the chairman. Meetings of the Board of Directors shall be held as often as the President considers it necessary, or at the request of at least two members.

Article 11

Conditions of appointment of manager

The Board of Directors may appoint and dismiss the manager. The manager is to be responsible for the daily business of the

association. In case of dismissal (apart from breach of contract) the manager of the co-operative dairy may demand that his dismissal be submitted to a general assembly within 14 days of his notice; in which case the dismissal shall not become effective unless agreed by at least half of the members of the association.

The manager shall be the technical representative of the association, and as such he shall have the right to engage and dismiss the personnel needed for the business.

Article 12

Accounts and treasurer's duties

The financial year of the association shall be from October to October, the treasurer shall be responsible for the keeping of cash accounts; whereas accounts concerning deliveries of milk, production, and retail sales etc. shall be kept at the dairy under the responsible supervision of the manager.

The annual financial statement is to show an account of profits and losses and a balance-sheet comprising assets and liabilities. The statement after being certified by the auditors, is to be signed by the members of the Board of Directors.

Article 13

Auditing

The audit of the accounts shall be undertaken by two auditors, to be elected by the general assembly and at least one of whom shall be a member of the association.

Moreover the accounts are controlled by the Federation of Danish Dairy Associations. The auditors, elected by the general assembly, are elected for a period of two years. After the end of the first year, one of the auditors (to be decided by lots) shall retire. Auditors may be re-elected.

The auditors shall have the right at any time to inspect all accounts of the association, as well as its bills, receipts etc., and to check the cash-in-hand. Any comments as to the book-keeping of the association shall be entered in a minute book, which shall also indicate what auditing has taken place.

Article 14

Dissolution of the association

The dissolution of the association is to be decided by a majority of three-quarters of the votes at two successive general assemblies, which are to be held at an interval of at least 8 days.

If a resolution to dissolve the co-operative dairy is passed, the general assembly shall elect a committee to effect the liquidation. The committee is to dispose of the assets of the association in the best possible way and finally allot the remaining capital assets or liabilities among the members proportionally to their average milk deliveries during the preceding ten years.

The co-operative dairy shall be regarded as dissolved when a general assembly has approved of and passed the account of the liquidation.

Article 15

Arbitration

Disputes between the co-operative dairy on the one hand and one or more of the members on the other hand shall be settled by arbitration.

In case of arbitration each of the parties has to appoint an honest, competent and impartial person as arbitrator. The local country judge joins the arbitration tribunal as umpire. The decision of the arbitration is to be final and conclusive, to the exclusion of Courts of Justice.

Article 16

These rules are to have effect from..... 19.....

Enacted by the general assembly of the co-operative dairy in.....
on.....19.....

Signed by the members of the Board of Directors,

APPENDIX E

Firms and Organizations Visited by the Team in Denmark & USA

Meat Products Laboratory of the Agricultural College, Roligheddevej 13, V

Ministry of Fisheries Research Laboratory, Oster Voldgade 10, K

Cremo Cheese Co. I/S Fredriksholms Havnevej 11, S. V

Plumrose Canning Factory, Hoffdingsvej 32-35, Vanlose

The Danish Meat Research Institute Roskilde

Plumrose Vegetable Canning Factory Havnegad 19, Odense

Odense Canning Factory, Middelfartsvej 1, Odense

GASA Auction Market

Haustrups Factories Naesbyvej 20, Odense

J. A. K. A., A. m. b. A. Bradbrand, Arhus

Danish Co-operative Creamery, Sumatravej, Arhus

M/s. Aktieselskabet, Passch & Silkeborg, Maskinfabrikker, Silkeborg

R. J. Peacock Canning Company, Brown's Wharf, Portland, Maine

Trident Packing Company, Brown's Wharf, Portland, Maine

Homes Packing Corporation, Portland, Maine

Seaboard Packing Corporation, South Portland, Maine

Northeast Cold Storage Corporation, Read Street, Portland, Maine

Lipman Poultry Company, Augusta, Maine

Research and Quality Control Laboratory of Maine, 114, Exchange Street, Bangor, Maine

F. H. Snow Canning Company, Incorporated Pine point, Maine

Maine Egg Producers, Scarboro, Maine

Willard Dagget Fish Company, Portland, Maine

U S Department of Health, Education and Welfare, Food and Drug Administration, Washington 25, D. C.

Washington International Centre, Meridian House Foundation, 1630 Crescent Place, N. W. Washington, D. C.

U S Department of Labour, Bureau of International Labour Affairs, Washington 25, D.C.

National Canners Association, Washington 25, D.C.

U S Department of Agriculture, Washington 25, D.C.

FMC Corporation, Hoopeston Plant, 103 East Maple Street, Hoopeston, Illinois

Illinois Canning Company, 215, West Washington Street, Hoopeston, Illinois

Stokeley-Van Camp, Incorporated, Hoopeston Plant, Hoopeston, Illinois

American Can Company, Maywood Container Research Laboratory, Maywood, Illinois

Sunkist Growers, Incorporated, 707 West 5th Street, Los Angeles 17, California

Van Camp Sea Food Company, 840 Van Camp Street, Long Beach, California

Food Giant Markets, Incorporated, 4707 District Boulevard, Los Angeles 58, California

FMC Corporation 1105, Coleman Street, San Jose 8, California

Libby, McNeill and Libby, Sunnyvale Plant, Sunnyvale, California

University of California, College of Agriculture, Department of Food Sciences and Technology, Davis, California

International Dairy Supply Company, Battery Street, San Francisco, California

H. J. Heinz Company, 212 East Highland Avenue Tracy, California

Oregon State University, School of Agriculture, Department of Food Science and Technology, Corvallis, Oregon

Blue Lake Packers, Salem, Oregon

Willamette Valley Cherry Growers, Salem, Oregon

Abe Edigar Farms, Route 99, Salem, Oregon

Northern Pacific Canners and Packers Incorporated, 5200 Southeast Mcloughlin Boulevard, Portland 2, Oregon

Northwest Packing Company, 440 North Columbia Boulevard, Portland 11, Oregon

Apple Growers Association, P. O. Box 180, Hood River, Oregon

preliminary report of the team's in-country tour

Introduction

THE PROBLEMS RELATING TO THE FOOD Preservation Industry were discussed by the members of the Productivity Study Team on Food Preservation and Canning Industry when they assembled at NPC headquarters, New Delhi, to finalise the terms of reference. The Team, sponsored by the National Productivity Council, India, with the assistance of US-AID, decided to undertake an in-country tour before its departure for abroad. The terms of study adopted by the members appear at Appendix A. The members also decided to use the same terms of study for the in-country tour.

In preparing the in-country tour programme it was decided to study large, medium and small units engaged in preservation of foods as well as the manufacture of containers and paper products. Consideration was also given to the need for study of the regional problems, and to selection of certain units which specialise in manufacture of important products such as canned pineapples, frozen and canned shrimps, dairy products and meat products. With this in view the Team visited a large number of units all over India as per itinerary given in the end.

The members of the Team are grateful to the management of various organisations for the valuable co-operation extended by them in giving the information and showing the work of their organisations, sometimes, at a very short notice. The visit of the Team to the various industrial units proved very educative and the discussion held at all centres generated a lot of enthusiasm on the problems of Productivity. The Team will endeavour to look for the soltuion of the problems of the industry and in their final report bring out recommendations which may be useful to the food preservation industry in particular, and in general to the industrial development in the country.

Responsibility for collecting information on different aspects of the problems as presented in the terms of study has been divided amongst the members so that it may be possible for each member to contribute positively to the work of the Team and make the final report well co-ordinated, comprehensive and useful.

Terms of Study

The terms of study covered a very wide area and presented rather difficult proposition over a short period of study within the country as well as abroad. The Team realised this but still felt that being given the opportunity of undertaking the assignment on the industry in which each member of the Team is a lifelong participant it should endeavour to complete the study.

The general study related to preservation of perishables i.e. fruits, vegetables, milk, fish and meat, while as a special subject of interest new developments of accelerated freeze drying and dietetic foods were included. The problems of study thus included almost all aspects of the industry. The in-country report attempts to highlight in some detail the questions for which the Team would try to find answers abroad.

The development of fruit, vegetable, milk, fish and meat processing in India does not date back even to a Pre-World War II period. The fruit and vegetable processing industry in India took its root during World War II while milk, fish and meat products we reinitiated in the 1950s. From the point of view of production, this industry is still in its infancy but when we compare the developments in western countries and the present rate of industrial progress in India there is no doubt that in very near future the possibilities of expansion would be immense. On a rough assessment it may be stated that it will take atleast another five to seven years before the food industry would reach a take off point. To the members of the Team the present period in this industry is a challenge and we are grateful to the National Productivity Council, India for sponsoring this Team at this appropriate time. We are confident that at this stage of the development our study will give us the opportunity to present a frame work which would be of real value and may contribute to the future development in a substantial manner.

Problems of Study

Raw Materials

It needs no repetition to emphasise that low yield of crops per acre, milk per animal, poor quality of meat and low catch per fishing craft, represent the general problem of high cost and poor quality of raw materials in the field of agriculture. It is reported that in U.P., a premier agricultural State, the yield of peas per acre is 50% lower than in U K. Similarly the yield of pineapples in Kerala is 3 to 4 tons per acre as compared to 18 to 20 tons per acre in Hawaii. This, therefore, is one of the basic problems of the industry and all attempts to improve yields will benefit the industry considerably as well as producer.

It is paradoxical, but true, that while only a very small percentage of the total production of perishables is untilised by the industry, there is general dissatisfaction with the quality of raw materials. Varieties of fruits and vegetables suitable for preservation are firstly not grown because there is a lack of information on the subject, and even if some research work has been done, on certain crops, there is a lack of dissemination of the results and extension work in this field. The Team should collect adequate information on the varieties suitable for preservation as well as techniques of extension work so that the industry would be in a position to propagate suitable varieties. Horticulture development with the assistance of the State Governments as well as through the associations of the growers needs to be studied, and suitable pointers indicated for adoptation in India.

The problem of collection of milk from small producers has been successfully solved by organisation of collection through the primary milk producers co-operative societies in the villages. This itself is a unique system but further increase in supplies will have to be attempted by expanding the areas of collection by introduction of chilling units at distant collection centres. However, the problem of quality of milk thus collected needs further study.

Incentives which are likely to lead to higher milk production have been attempted by means of free veterinary and other dairy development assistance, as well as by giving higher price for milk over a period of years; but the need for increase of productivity of the cattle, through general development of animal husbandry, warrants detailed study.

For the meat processing units a start has yet to be made from scratch. Although our country has the largest cattle population in the world, the methods of animal slaughter for use of fresh meat are primitive. Basically the problem is that we have no developed breeds of animals for the purpose and, therefore, not only the quality is poor but there is wastage of animals from the point of view of production of food for human comsumption and manufacture of valuable by-products. It is, therefore, obvious that the problem of study in this field, would be of basic interest to the industry.

The fish processing industry is of very recent origin. It is at present located along the West Coast and concentrated in the State of Kerala. The Norwagean Project has helped to improve the fishermen's lot in

State. The collection of raw material is being made more efficient although there are difficulties of providing refrigeration or ice to the fishing vessels and collecting fish or shrimps of suitable quality for preservation. However, the attempt is a very laudable one and the industry has been able to maintain high standards in raw materials to manufacture quality products which have been earning valuable foreign exchange for the last few years. The problem of development of suitable craft and gear for fishing under Indian conditions is being investigated by the Central Marine Fisheries Technological Research Institute, Cochin.

Pre-packing handling, transport and marketing of Raw Materials

It is estimated that 15 to 20 per cent of fruits and vegetables go to waste because of improper packaging, transport and marketing facilities. This is a great handicap both to the producers as well as to the preservers. This not only increases the cost but affects the quality of the raw material and thereby increases the problem at every stage of production. Improved packaging techniques for perishables, utilising readily available indigenous materials need to be introduced. The handling of perishables by railways is a problem of study in itself. Transportation by road over short distances and sometimes even over a long distance on good roads is developing fast and may bring good results. After a study abroad it may be possible to recommend improvements in this field.

In their own interest, the food processors will have to learn the technique of dealing with the producers and will have to devote themselves to encouraging and assisting growers in the field of marketing of perishables. We already know how the co-operatives have played a very important role in many countries of the world particularly in the food preservation industry. We will have to broaden our outlook by studying closely the co-operative movement in the field of marketing, as well as, processing of perishables.

A word may be said about storage and handling of perishables in the wholesale markets in India. Techniques employed in the auction and sales of perishables particularly in Denmark will give very valuable information on how efficiently perishables could be handled.

Production

This is the field in which the Team will face the most difficult task of judging the utility of foreign techniques in context with the present status of the indigenous industry. The progress made in the production methods in the USA as well as other advanced countries is immense and the techniques used are specially developed for mass production of particular items. It will be very easy to be enamoured with the production line operations and modern equipment and machinery used abroad and it is not unlikely that the Team may face much difficulty in recommending practical propositions for adoptation in India. The Team will have to guard against this at every stage of the study abroad.

The need for modernising various unit operations has been recognised and there is a desire to introduce modern equipment and machinery as well as techniques. Everywhere there is an urgency in this regard and general feeling that there is a strong case for liberal import policy for permitting the industry to obtain modern equipment and machinery from the advanced countries of the world. The Team agrees with this view, particularly as it is of opinion that manufacture of equipment in India may take considerable time and the demand for much of the specialised equipment and machinery needed at present is insufficient to justify machinery manufacturers to undertake its fabrication.

The point may be further emphasised for developing export trade. Unless modern techniques are emloyed the products will suffer both from the point of view of cost and quality. The Team should engage atttention to work out details of equipment and machinery which will help the industry in steping up productivity and quality.

Plant Layout and Services

In the factories which are being newly organised and established adequate attention is being given to layout and installation of service like power steam & water. However,

the older units suffer considerably on this score and may need complete reorientation for streamlining production. The shortage of power in many areas and in some places shortage of coal are serious handicaps. While water supply is adequate, the disposal of effluents and factory waste is a serious problem.

The Team should be interested in studying plant layout of particularly small-scale industries which process various items throughout the year. It may also note how to reduce construction cost of factory buildings, stores, godowns and other services. Study of new developments towards cheaper generation of steam and water supply will be helpful. Disposal of effluents and further utilisation of factory wastes for by-products will require particular attention. Everywhere the Team will have to keep in mind the limitation of small scale operation in factories in India.

Operational Research & Efficiency Studies

It may be admitted that in the present context of the state of industries, the need for operational research and efficiency studies has not been recognised. Cost studies and productivity consciousness will have to be recognised by many more in the industry. The Team will have to collect as much data as possible to make a convincing case for the wider adoptation of the techniques of operational research. Simple techniques have been known to yield very good results and at some places the management has successfully employed techniques developed from experience gained in day-to-day working. These techniques relate to issues like machine utilisation, workload, and man & machine relationship. What we need is presentation of case studies, and directions regarding methods suitable for adoptation by the industry.

Research & Scientific Control

Routine quality control is being practised by most of the well established units in India. Statistical quality control at every stage of production needs examination to work out suitable recommendations for adoptation in India. The research for developing depends on the scientists and the technologists now working in the industry. Somehow the pressure on the existing qualified personnel is heavy because of day-to-day problems and they are often not able to devote much time to development work. Also, there are only a very few organisations which can afford adequate expenditure on research and scientific work to obtain useful and productive results. At the moment development and research work is being carried out mainly by the national institutions like the Central Food Technological Research Institute, National Dairy Research Institutions, the Indian Council of Agriculture Research and other such institutions.

The industry will benefit considerably if more light is thrown on how the industry has organised co-operative research in the USA and other countries. A study of the relationship of research laboratories of the States, Universities and other institutions vis-a-vis the industry should bring to light useful suggestions for adoptation in India. Closer liaison and coordinated approach between the industry and research institutions will harness new thoughts and developments for the service of the industry and thereby increase productivity.

Food Laws & Standards

A study of legislative controls on the food industry in other countries will enable the Team to compare them with Indian conditions and will help the Team to suggest suitable remedies to the prevailing difficulties in India. The fulfilment of the requirements of food laws, the Team observed, at various placess, did affect the productivity at many stages of operation e.g. buying of raw materials, prepartion, packing, sealing, labelling, casing etc. The industry is facing difficulties in meeting many of the existing requirements of the law due to various reasons, but particularly because of duplication of authority exercised by the Ministry of Food and Agriculture and the Ministry of Health. There are also problems with regard to the methods adopted for evolution of food standards and other requirements. A study abroad

of the system of Federal and State control for standards prevention of food adulteration and continuous inspection of factories will provide good avenues to find answers to similar situations in India.

Containers

The food processing industry in India mainly uses cans and glass for containers. The use of flexible containers has good possibilities and is likely to come in the field in a big way in the near future.

Like canning industry the can makers also face problems concerning raw materials, import of machinery, marketing and distribution. The small demand for cans which again is fragmented into a number of different sizes makes it difficult to use tin plate economically. Apart from studying the different kinds of containers used in different countries attention will also be paid to reasons for using particular types of containers and also to assessing the efficacy of possible alternatives. There is also the feeling in the industry that in spite of certain amount of help by the Government the prices of tin containers, in India are high. A comparative study of the cost of containers and other packing materials to the industry in foreign countries will be a useful guide. The specification and the quality of containers, use of different types of lacquers, packing of empties, and last but not the least, the use of compact but less costly seamers and conveyors which may warrant adoption, would need particular study.

The glass containers in India are costly not only because of recent excise duties, but also due to the general high cost of raw materials used by the glass industry in India. The NPC Team on packaging has already gone into the problem of quality and cost of glass and other containers and, therefore, this Team will concentrate only on such problems as are of direct interest e.g. the closing devices, handling of glass bottles for smaller production and transport of empty bottles as well as finished products packed in glass.

As stated above, the industry would benefit considerably if new packaging techniques are adopted which will result in better acceptability of the products to the consumer, lower cost and efficient handling in the factories. Of course, along with this, there are problems of import of suitable machinery and equipment for packaging, e.g. it will be quite advantageous to use laminated containers for liquid milk and fruit juices but this cannot be introduced unless the vicious circle of producing the suitable laminates in India and creating demand by importing machinery by plants for use of these laminates, is broken.

Marketing & Distribution

Sales promotion, publicity and consumer education which create better markets are not yet employed by the industry in India in the manner and scale employed by more advanced countries. The problem is difficult to study, for a while few large organisations have been able to generate a market larger than can be met by their present capacities of production, it does not apply to the majority who are small-scale producers. At the moment many units which are small do not have adequate resources to market and distribute products with a suitable backing of sales promotion on a national basis. Sometimes the cost of small-scale units seems to work out higher as compared to larger units which have facilities of merging overheads and production cost on a wider basis of turnover, which may cover different units of production. The answer should be found as to how to bring about healthy co-existence of small and large scale manufacturers or what techniques should each follow to be able to develop the industry.

There is a very high incidence of freight on processed food in India. Besides this, the requirement of packing insisted upon by the railways makes the packages, although conventional, rather heavy and costly. A study of the modern methods of packaging and handling, as also of the railway and other freight incidence, will give us an idea how to improve matters in this direction.

The pattern of relationship of the manufacturers with the wholesalers, dealers and retailers has considerable bearing on

manufacturing programme, stocking of raw materials and efficiency of handling every stage of production and storage of finished products. The efficient inter-linking of these aspects will prove very valuable to the industry and corrective measures if adopted will substantially contribute to the productivity of many units.

Industrial Relations

In general, during the past few years, industrial relations in India have been fairly healthy and this is also the case of industrial relations in the food processing industry. There are, however, problems which may arise due to rationalisation in the industry. How this problem is tackled, along with the problem of improving the performance of the worker, will give useful material for discussion by the Team.

It is, however, important to note that under the existing conditions in India, productivity is very much dependent on the human element and suffers due to a lack of efficient man-machine relationship in many units. Many organisations have found that incentives have not proved useful in increasing efficiency. There has also been some opposition in this regard from the trade unions. Without affecting the employer/employee relationship, suggestions should be worked out how we can increase the productivity of employees.

Training of Supervisory and Management Personnel

Some training has been organised for the supervisory staff working in the dairy field by FAO. Such training programmes for other food processing industry would be very beneficial. The training of management personnel has been arranged at Government levels but there is little evidence yet of the industry undertaking programmes of in-service training. However, such ideas are taking root and it is likely that the usefulness of in-service training will be appreciated and adopted by the industry in not distant future. Such training programmes will be easy to organise if properly worked out and presented to members of the industry along with estimates of the expenses involved.

Management and Financial Control

Although this appears first on the list of terms of study of the Team for the purpose of discussion, in this report it seems more convenient to present it at the concluding stage. Experience has shown that in a developing economy finance has in general not been a big impediment. Well managed organisations have been able to finance new projects as well as expand the existing ones, maintaining at the same time a reasonable amounts of profits, including certain amount of retention for ploughing back into the industry. This picture is, of course, not universal, and some of the small-scale units which although specially helped by the Government, have met with difficulties of finance mainly due to slow turnover and low rate of growth of a market for their products.

As already indicated in the report the industry needs stricter scrutiny of cost control at all levels, efficiency and productivity at various stages of production as many of the major problems arise due to a lack of budgetary control, inventory control, lack of planning in turnover of products and inefficient utilisation of production capacities. More attention on the management control should yield better results.

To judge the performance of the industry in India it will be useful to get an idea abroad of (a) balance-sheet ratios e.g. working capital ratio, proprietory ratio, liquid ratio; (b) trading and profit & loss account ratios e.g. gross profit ratio, operating ratio, expenses ratio, turnover ratio; and (c) inter-statement ratio e. g. net yield ratio, net profit and proprietory ratio, current assets and turnover ratio and net sales and trade receivable ratio.

SUMMARY

1. The general study relates to preservation of perishables i. e. fruits, vegetables, milk, fish and meat, while, as special subjects of interest, new developments of accelerated freeze drying and dietetic foods have been included.

2. If we look at the general picture of the industrial growth and development in India it shows positive trends of development even for this industry but on a frank assessment one can only state that it will take at least another five to seven years before the industry would reach a take-off stage.

3. Low productivity in horticulture crops, of animals for milk or meat and of the fishing, craft reflects the general problem of low production in the field of agriculture.

4. Varieties of fruits and vegetables suitable for preservation are not grown, firstly, because there is a lack of information on the subject and secondly, even if some research work has been done there is a lack of dissemination of the results and of extension work in the field.

5. In the milk and meat products industry, basically the problem is that we have no developed breeds for the purpose and, therefore, not only there is wastage of animals from the point of view of production of food for human consumption, but also of very important by-products.

6. It is estimated that 15 to 20 per cent of fruits and vegetables go to waste because of improper packaging, transport and marketing facilities.

7. The food processors will have to establish direct contact with producers and will have to encourage and assist the growers in the marketing of perishables.

8. It will no doubt be very easy to be impressed by the streamline processing techniques, the equipment and machinery used for various unit operations abroad, and it is not unlikely that the Team may face considerable difficulty in recommending practical propositions for adoption in India.

9. The Team will be interested in studying plant layout of small-scale industries processing various items throughout the year. It may also note how to reduce construction cost of factory buildings, stores, godowns and other services. It would be useful to study new developments in cheaper generation of steam and water supply. Disposal of effluent, and further utilisation of factory waste for by-products should receive special attention.

10. The Team will have to collect as much data as possible to make a convincing case for adoption of the techniques of operational research.

11. The industry will benefit considerably if more light is thrown on how the industry is organised in the USA and in other countries on a co-operative basis for research and scientific development. The relationship of research laboratories of the State, universities and other institutions vis-a-vis the industry should give rise to useful suggestions for the Indian industry.

12. The system of Union and State control of standards for the prevention of food

adulteration and continuous inspection of factories will also be studied.

13. The specification and the quality of containers, the use of different types of lacquers, packing of empties and, last but not the least, use of compact but less costly seamers and conveyors, which may warrant adoption, would need particular study.

14. The answer should be found how to bring about healthy coexistence of small and large-scale manufacturers and what technique each should follow to help develop the industrial economy of the country.

15. The pattern of relationships of the manufacturers with the wholesalers, dealers and retailers has considerable bearing on manufacturing programme, stocking of raw materials and efficiency of handling at every stage of production and storage of finished products.

16. Without adversely affecting the employer/employee relationship suggestions should be made for increasing the productivity of the employees.

17. As already indicated in the report, the industry needs stricter scrutiny of cost control at all levels, efficiency and productivity at various stages of operation but often it has been noticed that major problems arise due to lack of budgetary control, inventory control, planned turnover of products and full utilisation of production capacities.